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In The Supreme Court of the United States

October Term, 1982

Baltimore Gas and Electric Co., *et al.*,
Petitioners,

v.

Natural Resources Defense Council, Inc.,
Respondent.

APPENDIX TO PETITION FOR A WRIT OF CERTIORARI TO THE UNITED STATES COURT OF APPEALS FOR THE DISTRICT OF COLUMBIA CIRCUIT

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United States Court of Appeals

FOR THE DISTRICT OF COLUMBIA CIRCUIT

No. 74-1586

NATURAL RESOURCES DEFENSE COUNCIL, INC. AND CONSOLIDATED NATIONAL INTERVENORS, PETITIONERS

v.

UNITED STATES NUCLEAR REGULATORY COMMISSION AND UNITED STATES OF AMERICA, RESPONDENTS

BALTIMORE GAS AND ELECTRIC CO., ET AL., INTERVENORS

No. 77-1448

NATURAL RESOURCES DEFENSE COUNCIL, INC., PETITIONER

v.

UNITED STATES NUCLEAR REGULATORY COMMISSION AND UNITED STATES OF AMERICA, RESPONDENTS

BALTIMORE GAS AND ELECTRIC COMPANY, ET AL., COMMONWEALTH EDISON COMPANY, PACIFIC LEGAL FOUNDATION, INTERVENORS

Bills of costs must be filed within 14 days after entry of judgment. The court looks with disfavor upon motions to file bills of costs out of time.

No. 79-2110

THE STATE OF NEW YORK, PETITIONER

v.

UNITED STATES NUCLEAR REGULATORY COMMISSION AND THE UNITED STATES OF AMERICA, RESPONDENTS

COMMONWEALTH EDISON COMPANY, ET AL., TENNESSEE VALLEY AUTHORITY, BALTIMORE GAS AND ELECTRIC CO., ET AL., STATE OF WISCONSIN, INTERVENORS

No. 79-2131

NATURAL RESOURCES DEFENSE COUNCIL, INC., PETITIONER

v.

UNITED STATES NUCLEAR REGULATORY COMMISSION AND UNITED STATES OF AMERICA, RESPONDENTS

COMMONWEALTH EDISON COMPANY, ET AL., TENNESSEE VALLEY AUTHORITY, BALTIMORE GAS AND ELECTRIC COMPANY, ET AL., INTERVENORS

Petitions for Review of Orders of the Nuclear Regulatory Commission

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Argued September 17, 1980

Decided April 27, 1982

Ronald J. Wilson for Natural Resources Defense Council, petitioner in Nos. 74-1586, 77-1448 and 79-2131. *Roger Beers* also entered an appearance for petitioner, Natural Resources Defense Council.

E. Leo Slaggie, Attorney, Nuclear Regulatory Commission, with whom *Sanford Sagalkin*, Acting Assistant Attorney General, *David Shilton*, Attorney, Department of Justice, and *Stephen E. Eilperin*, Solicitor, Nuclear Regulatory Commission, were on the brief, for respondents. *George R. Hyde*, *Edward J. Shawaker* and *John J. Zimmerman*, Attorneys, Department of Justice, also entered appearances for respondents.

Ezra I. Bialik, Assistant Attorney General, State of New York, with whom *Robert Abrams*, Attorney General, State of New York, and *Bronson C. LaFollette*, Attorney General, and *Patrick Walsh*, Assistant Attorney General, State of Wisconsin, were on the joint brief, for petitioner, State of New York, and intervenor, State of Wisconsin, in No. 79-2110.

Donald P. Irwin and *K. Dennis Sisk* were on the brief for intervenors Baltimore Gas and Electric Company, et al., in Nos. 74-1586, 77-1448, 79-2110 and 79-2131. *George C. Freeman, Jr.* also entered an appearance for intervenors, Baltimore Gas and Electric Company, et al.

Charles W. Van Beke and *M. Elizabeth Culbreth* were on the brief for intervenor Tennessee Valley Authority in Nos. 79-2110 and 79-2131.

James P. McGranery, Jr. and *Margaret R. A. Paradis* were on the brief for intervenors and *amici curiae*, Commonwealth Edison Company, in Nos. 74-1586, 77-1448, 79-2110 and 79-2131. *Richard D. Cudahy* entered an appearance for intervenor, Commonwealth Edison Company.

Ronald A. Zumbrun, *Raymond M. Momboisse*, *Albert Ferri, Jr.* and *Lawrence P. Jones* entered apperances for intervenor, Pacific Legal Foundation.

Before: BAZELON, *Senior Circuit Judge*, GEORGE C. EDWARDS, JR.,* *Circuit Judge* for the Sixth Circuit, and WILKEY, *Circuit Judge*.

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* Sitting by designation pursuant to 28 U.S.C. § 291(a).

Opinion for the Court filed by *Senior Circuit Judge* BAZELON.

Opinion concurring in part and dissenting in part filed by *Circuit Judge* EDWARDS.

Dissenting opinion filed by *Circuit Judge* WILKEY.

PER CURIAM: Judge Bazelon's opinion constitutes the opinion of the court. Judge Edwards concurs in all but Part IV-D of the opinion, and Judge Wilkey concurs in only Part IV-D.

BAZELON, *Senior Circuit Judge*: These consolidated cases involve the continuing efforts of the Nuclear Regulatory Commission (NRC)[1] to establish a system by which to consider and disclose the environmental impact of the uranium fuel cycle in compliance with the National Environmental Policy Act (NEPA).[2] The present controversy centers upon the radiological effluents associated with the "back end" of the fuel cycle: the reprocessing,[3] storage, and "disposal"[4] of spent fuel and other

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[1] The Nuclear Regulatory Commission (NRC) was established by the Energy Reorganization Act of 1974, 42 U.S.C. §§ 5801 *et seq.* (1976), to assume the licensing and regulatory functions of the Atomic Energy Commission (AEC). The administrative proceedings challenged in this action began under the AEC and continued under the NRC. Hereinafter both agencies will be referred to as the "Commission" or the "NRC."

[2] 42 U.S.C. § 4332 (1976).

[3] "Reprocessing" is a process by which reusable elements of spent fuel are extracted for recycling and the remaining radioactive wastes are concentrated.

[4] As we stated in our initial opinion in this case, waste "disposal" is a misnomer for what, under currently projected technology, should be termed long-term waste storage. It refers to the last stage of the waste-management process, where wastes are expected to be contained for the tens of thousands of years necessary for them to decay naturally into nontoxic substances. *But see* p. 39 *infra* (other disposal methods under consideration).

wastes. At issue are three versions—the original,[5] interim,[6] and final versions[7]—of the "Table S-3 Rule," which provide a set of numerical values intended to reflect the environmental effects of the uranium fuel cycle.[8] Under the Rule, Table S-3 is to be included in

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[5] 39 Fed. Reg. 14188 (1974).

[6] 42 Fed. Reg. 13803 (1977).

[7] 44 Fed. Reg. 45362 (1979) (codified at 10 C.F.R. §§ 51.20(e) & 51.23(c) (1981)). The original Rule was codified at 10 C.F.R. Part 50 App. D and then transferred to 10 C.F.R. §§ 51.20(e) & 51.23(c). 39 Fed. Reg. 26279 (1974). The interim and final Rules amended those two sections. Hereinafter only Federal Register citations will be noted.

Although the original and interim Rules have been superceded by the final Rule, their validity is still at issue. Individual licenses that were granted under those Rules have been challenged in separate actions, many of which are being held in abeyance pending the resolution of the broader issues presented in this case. In this circuit alone there are at least five such cases. Lloyd Harbor Study Group, Inc. v. NRC, No. 73-2266; Aeschliman v. NRC, No. 73-1776; Saginaw Valley Study Group v. NRC, No. 73-1867; NRDC v. NRC, No. 74-1385; Coalition for the Environment v. NRC, No. 77-1905.

[8] The Rule is referred to as the "Table S-3 Rule" because the Table, which originated in a staff report, was initially labeled "S-3." *See* p. 16 *infra*. In most relevant respects, differences among the three versions of the Table S-3 Rule are insignificant. References to the "Table" or the "Rule," therefore, refer to all versions.

The fuel cycle activities addressed by the Table include uranium mining and milling, the production of uranium hexafluoride, isotopic enrichment, fuel fabrication, spent-fuel storage and disposal, reprocessing of irradiated fuel, transportation of radioactive materials and management of low-level and high-level wastes. For an explanation of the fuel cycle, *see* NRDC v. NRC, 547 F.2d 633, 637 n.3 (D.C.Cir. 1976), *rev'd sub nom.* Vermont Yankee Nuclear Corp. v. NRDC, 435 U.S. 519 (1978). As stated above, these cases concern only the waste-management and disposal aspects of the Table. The final version of the Table is reproduced below.

Table S-3.—*Table of Uranium Fuel Cycle Environmental Data* [1]
[Normalized to model LWR annual fuel requirement [WASH-1248] or reference reactor year [NUREG-0116]]

Environmental considerations	Total	Maximum effect per annual fuel requirement or reference reactor year of model 1,000 MWe LWR
NATURAL RESOURCES USE		
Land (acres):		
Temporarily committed [2]	100	
Undisturbed area	79	
Disturbed area	22	Equivalent to a 110 MWe coal-fired power plant.
Permanently committed	13	
Overburden moved (millions of MT)	2.8	Equivalent to 95 MWe coal-fired power plant.
Water (millions of gallons):		
Discharged to air	160	=2 percent of model 1,000 MWe LWR with cooling tower.
Discharged to water bodies	11,090	
Discharged to ground	127	
Total	11,377	<4 percent of model 1,000 MWe LWR with once-through cooling.
Fossil fuel:		
Electrical energy (thousands of MW-hour)	323	<5 percent of model 1,000 MWe LWR output.
Equivalent coal (thousands of MT)	118	Equivalent to the consumption of a 45 MWe coal-fired power plant.
Natural gas (millions of scf)	135	<0.4 percent of model 1,000 MWe energy output.
EFFLUENTS—CHEMICAL (MT)		
Gases (including entrainment): [3]		
SO_x	4,400	
NO_x [4]	1,190	Equivalent to emissions from 45 MWe coal-fired plant for a year.
Hydrocarbons	14	
CO	29.6	
Particulates	1,154	
Other gases:		
F	.67	Principally from UF_6 production, enrichment, and reprocessing. Concentration within range of state standards—below level that has effects on human health.
HCl	.014	

Table S-3.—Continued

Environmental considerations	Total	Maximum effect per annual fuel requirement or reference reactor year of model 1,000 MWe LWR
Liquids:		
SO_4	9.9	From enrichment, fuel fabrication, and reprocessing steps. Components that constitute a potential for adverse environmental effect are present in dilute concentrations and receive additional dilution by receiving bodies of water to levels below permissible standards. The constituents that require dilution and the flow of dilution water are: NH_3—600 cfs. NO_3—20 cfs. Fluoride—70 cfs.
NO_3	25.8	
Fluoride	12.9	
Ca^{++}	5.4	
Cl^-	8.5	
Na^+	12.1	
NH_3	10.0	
Fe	.4	
Tailings solutions (thousands of MT)	240	From mills only—no significant effluents to environment.
Solids	91,000	Principally from mills—no significant effluents to environment.
EFFLUENTS—RADIOLOGICAL (CURIES)		
Gases (including entrainment):		
Rn-222		Presently under reconsideration by the Commission.
Ra-226	.02	
Th-230	.02	
Uranium	.034	
Tritium (thousands)	18.1	
C-14	24	
Kr-85 (thousands)	400	
Ru-106	.14	Principally from fuel reprocessing plants.
I-129	1.3	
I-131	.83	
Tc-99		Presently under consideration by the Commission.
Fission products and transuranics	.203	
Liquids:		
Uranium and daughters	2.1	Principally from milling—included tailings liquor and returned to ground—no effluents, therefore, no effect on environment.
Ra-226	.0034	From UF_6 production.
Th-230	.0015	

Table S-3.—Continued

Environmental considerations	Total	Maximum effect per annual fuel requirement or reference reactor year of model 1,000 MWe LWR
Th-234	.01	From fuel fabrication plants—concentration 10 percent of 10 CFR 20 for total processing 26 annual fuel requirements for model LWR.
Fission and activation products	5.9×10^{-6}	
Solids (burned on site):		
Other than high level (shallow)	11,300	9,100 Ci comes from low level reactor wastes and 1,500 Ci comes from reactor decontamination and decommissioning—buried at land burial facilities. 600 Ci comes from mills—included in tailings returned to ground. Approximately 60 Ci comes from conversion and spent fuel storage. No significant effluent to the environment.
TRU and HLW (deep)	1.1×10^{7}	Buried at Federal Repository.
Effluents—thermal (billions of British thermal units)	4,063	<5 percent of model 1,000 MWe LWR.
Transportation (person-rem):		
Exposure of workers and general public	2.5	
Occupational exposure (person-rem)	22.6	From reprocessing and waste management.

[1] In some cases where no entry appears it is clear from the background documents that the matter was addressed and that, in effect, the Table should be read as if a specific zero entry had been made. However, there are other areas that are not addressed at all in the Table. Table S-3 does not include health effects from the effluents described in the Table, or estimates of releases of Radon-222 from the uranium fuel cycle or estimates of Technetium-99 released from waste management or reprocessing activities. These issues may be the subject of litigation in the individual licensing proceedings.

Data supporting this table are given in the "Environmental Survey of the Uranium Fuel Cycle," WASH-1248, April 1974; the "Environmental Survey of the Reprocessing and Waste Management Portion of the LWR Fuel Cycle," NUREG-0116 (Supp. 1 to WASH-1248); the "Public Comments and Task Force Responses Regarding the Environmental Survey of the Reprocessing and Waste Management Portions of the LWR Fuel Cycle," NUREG-0216 (Supp. 2 to WASH-1248); and in the record of the final rulemaking pertaining to Uranium Fuel Cycle Impacts from Spent Fuel Reprocessing and Radio-

the environmental impact statement (EIS)[9] of each proposed light water nuclear power reactor, and thereby substitute for repeated individualized consideration of the environmental impact of the fuel-cycle activities needed to support each plant.[10]

Table S-3.—Continued

active Waste Management, Docket RM-50-3. The contributions from reprocessing, waste management and transportation of wastes are maximized for either of the two fuel cycles (uranium only and no recycle). The contribution from transportation excludes transportation of cold fuel to a reactor and of irradiated fuel and radioactive wastes from a reactor which are considered in Table S-4 of § 51.20(g). The contributions from the other steps of the fuel cycle are given in columns A-E of Table S-3A of WASH-1248.

[2] The contributions to temporarily committed land from reprocessing are not prorated over 30 years, since the complete temporary impact accrues regardless of whether the plant services one reactor for one year or 57 reactors for 30 years.

[3] Estimated effluents based upon combustion of equivalent coal for power generation.

[4] 1.2 percent from natural gas use and process.

10 C.F.R. § 51.20(e) (1981).

[9] In this opinion, "EIS" shall refer to the applicant's Environmental Report as well as the Draft and Final Statements for both the construction and operating license stages. 10 C.F.R. §§ 51.20-51.26 (1981). The Rule specifices a single set of data to be used in all of these documents. *Id.* at §§ 51.20 (e), 51.23(c), 51.26(a) (1981).

[10] Licensing and Regulatory Policy and Procedures for Environmental Protection, 10 C.F.R. Part 51 (1981).

Section 102(2)(C) of NEPA requires the EIS to accompany the license application through the existing review process. The Commission's general rules implementing NEPA provide that when matters covered by the EIS are at issue, the staff will offer the EIS in evidence at the adjudicatory hearing, and any party may take a position and offer evidence as well. The presiding officer will then decide the matters in controversy among the parties. 10 C.F.R. § 51.52(b) (1981). If such matters are resolved by rule, they are generally not subject to attack by way of discovery, proof, argument or other means in the adjudicatory proceeding. *See* 10 C.F.R. § 2.758 (1981).

The issues in this case largely concern the use of numerical values to depict the environmental effects of fuel-cycle activities. By describing such effects in this manner, the issue arises whether there is more to the fuel cycle's environmental impact than the bare numbers in the Table reveal, and, if so, whether licensing boards are prevented from looking beyond the Table to consider additional elements of the fuel cycle's environmental impact. One omission from the Table is explicit recognition of the uncertainties that underlie the projected effluent releases. This omission is particularly glaring in the Table's treatment of the long-term effects of solid high-level and transuranic wastes, which remain toxic for at least 250,000 years.[11] The Commission expects to dispose of those wastes, perhaps by first reprocessing a portion

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[11] *See* NRDC v. NRC, 547 F.2d 633, 638-39, 651-52 & n.54 (D.C. Cir. 1976), *rev'd sub nom.* Vermont Yankee Nuclear Power Corp. v. NRDC, 435 U.S. 519 (1978); note 14 *infra*. High-level wastes, which are highly radioactive, are produced in liquid form when spent fuel is reprocessed. Transuranic wastes are nuclides heavier than uranium that are produced in the reactor fuel. These nuclides, which are also highly toxic and may have half-lives of tens of thousands of years, can contaminate pieces of the fuel apparatus. As a result, hardware, particularly from reprocessing plants will have to be disposed of in a permanent repository.

The Commission has considered three possible fuel cycles: the "once-through," cycle in which fuel is not reprocessed; the uranium-only reprocessing cycle; and, for a short time, the uranium and plutonium reprocessing cycle. Transuranic and high-level wastes are produced in both reprocessing cycles. The uranium-only cycle also produces plutonium, which must be disposed of with the transuranic and high-level wastes. In the once-through cycle, the spent-fuel assemblies themselves constitute the waste. Table S-3 is intended to represent the environmental impact of both the once-through and the uranium-only recycle options, which are the only options under current consideration. The Table does so by listing, for each effluent, the highest of the two releases that would be expected under each cycle. 41 Fed. Reg. 45849, 45850 (1977).

of them, and in any event, by burying them in salt mines beneath the continental United States. The Tables indicate that the wastes will have no effect on the environment after they are sealed in salt mines.[12] In effect, therefore, the Table S-3 Rules instruct all licensing boards, when analyzing the environmental impact of a particular plant, to conclusively assume that such wastes will emit no radiological effluents into the environment after final burial.

The second omission from the Table is a description of the health, socioeconomic, and cumulative effects of the projected releases. The Table describes effluent releases in units of radioactivity per year. It does not evaluate the actual effects of those releases on human health, or on social and economic well-being, as an increasing number of plants continue to produce wastes. The issue raised by this aspect of the Table is whether the Table S-3 Rule allows licensing boards to take evidence on and consider those effects in individual licensing proceedings.[13] Finally, the effluent releases predicted in the Table are based on assumptions concerning the future availability of certain types of waste-management and disposal technology. The issue arises, therefore, whether the Commission has correctly found that the predicted releases represent technological goals that are economically feasible.

We conclude that the Table S-3 Rules are invalid because they fail to allow for proper consideration of the uncertainties concerning the long-term isolation of high-level and transuranic wastes, and because they fail to

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[12] Actually, high-level and transuranic wastes are not even listed in the original Table. *See* 39 Fed. Reg. 14188, 14191 (1974).

[13] The final Rule has eliminated this defect by explicitly requiring licensing boards to consider these impacts in individual proceedings pending the promulgation of a more complete generic resolution. 44 Fed. Reg. 45362, 45371 (1979). Petitioners, therefore, only challenge the original and interim Rules on this ground. NRDC Brief at 18, 31, 38.

allow for proper consideration of the health, socioeconomic and cumulative effects of fuel-cycle activities. Therefore, we remand.

I. BACKGROUND

Although a great deal remains to be learned about radioactive wastes, this much is known: 1) many of the wastes remain extremely toxic for a very long time;[14]

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[14] Neither the toxicity of radioactive wastes nor the time required for their decay to safe levels can be simply stated. Both involve uncertainties and disputed assumptions and both depend on other variables. *See* NATIONAL ACADEMY OF SCIENCES, NATIONAL RESEARCH COUNCIL COMMITTEE ON THE BIOLOGICAL EFFECTS OF IONIZING RADIATION, *The Effects on Populations of Exposure to Low Levels of Ionizing Radiation* (1980) [hereinafter cited as BEIR Report]; U.S. NUCLEAR REGULATORY COMM'N, ENVIRONMENTAL SURVEY OF THE REPROCESSING AND WASTE MANAGEMENT PORTIONS OF THE LWR FUEL CYCLE 4-90 to 4-92 (NUREG-0116, Oct. 1976) [hereinafter cited as NUREG-0116]. NUREG-0116 is included in the Joint Appendix Supplement as Volume V [hereinafter the Joint Appendix is cited as JA, and the Joint Appendix Supplement as JAS]. [To avoid repetition, page citations will refer to NUREG-0116 and not to same page numbers in the JAS.] One federal government report summarizes the problem as follows:

> Waste consists of radioactive species of almost all chemical elements; some contain naturally occurring radioactive materials and others contain man-made radioactive materials; the wastes exist as gases, liquids, and solids. Yet for all their variety, radioactive wastes have one thing in common: as long as they remain highly radioactive, they will be potentially hazardous. This potential hazard results from the fact that exposure to and/or uptake of radioactive material can cause biological damage.
>
> In man, it can lead to death directly through intense exposure and a variety of diseases, including cancer, which can be fatal. In addition, radioactive material can be mutagenic thereby transmitting biological damage into the future.
>
> The central scientific fact about radioactive material is that there is no method of altering the period of time in

2) the NRC has yet to settle upon a method for permanently disposing of radioactive wastes;[15] and 3) none of the current proposals for disposal is certain to succeed.[16] For more than a decade, and in several different arenas, the Natural Resources Defense Council (NRDC) has sought to force the Commission to factor this knowledge into its licensing decisions, each of which represents a decision to create additional nuclear wastes.[17]

A. *The Original Table S-3 Rule*

In April 1971, the NRDC attempted to raise the environmental impact of nuclear waste as a relevant consideration in the operating license proceeding for the Vermont Yankee Nuclear Power Station.[18] NRDC argued that

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which a particular species remains radioactive, and thereby potentially toxic and hazardous without changing that species. Only with time will the material decay to a stable (non-radioactive) element. The pertinent decay times vary from hundreds of years for the bulk of the fission products to millions of years for certain of the actinide elements and long-lived fission products. Thus, if present and future generations are to be protected from potential biological damage, a way must be provided either to isolate waste from the biosphere for long periods of time, to remove it entirely from the earth, or to transform it into non-radioactive elements.

INTERAGENCY REVIEW GROUP ON NUCLEAR WASTE MANAGEMENT, REPORT TO THE PRESIDENT 8-9 (TID-29442, March 1979) [hereinafter cited as IRG REPORT].

[15] NUREG-0116, *supra* note 14, at 4-72. *See also* 44 Fed. Reg. 45362, 45374 (1979) (Separate Views of Commissioner Gilinsky).

[16] *See* pp. 40-41 *infra*. *See also* 44 Fed. Reg. 45362, 45368 (1979); *id.* at 45374 (Separate Views of Commissioner Gilinsky).

[17] The term "license" as used in this opinion, shall refer to both construction permits and operating licenses.

[18] Order Determining Objections to Interrogatories Submitted by Natural Resources Defense Council, In re Vermont

such a licensing proceeding was the only decisionmaking stage at which the issue could be raised effectively, for at any later stage a commitment to produce potentially dangerous waste would have already been made. The Atomic Safety and Licensing Board (ASLB), however, rejected the NRDC's request.[19] It refused to admit evidence or permit questions on the environmental impact of Vermont Yankee's spent fuel or other radioactive waste products.[20]

In June 1972 the Atomic Safety and Licensing Appeal Board (ASLAB) upheld the ASLB's decision. The Appeal Board based its ruling on the fact that fuel-cycle effects were both speculative and remote. Because spent fuel and wastes would be removed from the plant, the

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Yankee Nuclear Power Corp. (Vermont Yankee Nuclear Power Station), Docket No. 50-271, U.S. Atomic Energy Comm'n, Atomic Safety and Licensing Board (May 11, 1971).

[19] A proposed nuclear plant goes through an extensive licensing process before coming on line. *See* 10 C.F.R. § 2.50 (1981). Before construction may begin, the Commission must issue a plant a construction permit. *Id.* at § 50.10(b). Then, before a plant may begin operation, the Commission must issue it an operating license. *Id.* at § 50.10(a). At each point, an applicant must prove that it will be able to run the plant properly, that the plant will meet the necessary safety standards, and that the benefits of the plant outweigh its costs. *Id.* at §§ 50.40, 50.42. Each decision is first rendered by the Atomic Safety and Licensing Board (ASLB) and is then reviewable by the Atomic Safety and Licensing Appeal Board (ASLAB). *Id.* at § 2.785. The Commission itself has the discretionary power to hear appeals from the ASLAB. *Id.* at § 2.786. The Commission also has generic rulemaking power. *Id.* at §§ 2.800-2.801.

[20] Order Determining Objections to Interrogatories submitted by Natural Resources Defense Council, In re Vermont Yankee Nuclear Power Corp. (Vermont Yankee Nuclear Power Station), Docket No. 50-271, U.S. Atomic Energy Comm'n, Atomic Safety and Licensing Board (May 11, 1971). *See* In re Vermont Yankee Nuclear Power Corp. (Vermont Yankee Nuclear Power Station), ALAB-56, 4 A.E.C. 930 (1972).

Board stated, their effects should be considered in proceedings to license future reprocessing plants and waste repositories—not in Vermont Yankee's licensing proceeding.[21]

In November 1972, the Commission responded to the ASLAB's *Vermont Yankee* decision by publishing a notice of proposed rulemaking to determine whether, and if so, how, it should consider the environmental impact of the fuel cycle as it continued licensing nuclear facilities.[22] The notice proposed two alternatives. The first alternative would have precluded any consideration of the environmental effects of radioactive wastes on the ground that those effects would not significantly affect the outcome of any licensing decision.[23] The second alternative would have limited disclosure and consideration of the environmental effects of these wastes to a table of predetermined numerical values, which was reproduced in the notice.[24] The values were standardized to represent the expected

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[21] 4 A.E.C. at 934-36. The Atomic Safety Licensing and Appeal Board did reverse the Licensing Board to the extent that the latter board had excluded evidence on the environmental effects of transporting spent fuel and other wastes to and from the plant, and of decontaminating and decommissioning the plant at the end of its useful life. *Id.* at 939.

[22] 37 Fed. Reg. 24191 (1972).

[23] *Id.* at 24192. The Commission staff had recently completed a study that reached that conclusion. ENVIRONMENTAL SURVEY OF THE NUCLEAR FUEL CYCLE (November 6, 1972). The Commission later revised the SURVEY and published it as ENVIRONMENTAL SURVEY OF THE URANIUM FUEL CYCLE (WASH-1248, April, 1974) [hereinafter cited as WASH-1248]. [All references to the SURVEY will be to WASH-1248, which is included in the Joint Appendix as Volume II. To avoid repetition, page citations will refer to WASH-1248 and not to the same page numbers in the J.A.] The revised SURVEY added a discussion of waste management and reprocessing based on the testimony at the rulemaking hearing of Dr. F.K. Pittman, Director of the AEC's Division of Waste Management. WASH-1248 at iv.

[24] 37 Fed. Reg. 24192-93 (1972).

contribution of one 1,000 megawatt light water nuclear reactor. The Commission staff had already derived the necessary values and reported them in Table S-3 of the Commission's *Environmental Survey of the Nuclear Fuel Cycle*.[25] The Table contained entries for the environmental effects of most stages of the uranium fuel cycle, but it contained no entry for the radiological effluents from solidified high-level and transuranic wastes. These wastes, which must be isolated from the environment for hundreds of thousands of years, were expected to be buried eventually in a federal repository somewhere beneath the continental United States. The original Table contained no values for the environmental impact of this final stage of the fuel cycle because the Commission staff believed that technology would be developed by which to isolate the wastes from the environment for an indefinite period of time.[26] Thus, both alternative proposals were based on the assumption that long-term waste-disposal systems, yet to be developed, would work perfectly. On the basis of such assumptions, the Commission proposed to mandate that licensing boards presume, in their decisions to grant nuclear power plant licenses, that there would be no risk of waste-disposal failure.

On April 16, 1974, the Commission adopted the Table S-3 alternative and amended its NEPA regulations to allow for consideration of the environmental effects of the uranium fuel cycle by including Table S-3 in the

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[25] The notice referred to WASH-1248, *supra* note 23, as providing support for Table S-3. 37 Fed. Reg. 24192 n.1.

[26] WASH-1248 states:

> The facility will be designed to prevent the release of significant amounts of radioactive material to the environment under all credible environmental conditions and human actions. Therefore, such wastes will not be released as effluents to the environment.

Id. at S-23.

EIS for each light water nuclear reactor.[27] The Rule also provided that the environmental effects of the fuel cycle "shall be as set forth in Table S-3," and that "no further discussion of such environmental effects shall be required."[28] In the meantime, the Vermont Yankee plant itself had been granted a full-term, full-power operating license,[29] and the Appeal Board had expressly declined to reexamine their earlier decisions precluding inquiry into the environmental impact of the fuel cycle.[30]

The NRDC challenged both the Table S-3 Rule and Vermont Yankee's license in this court.[31] We found that the procedures that the Commission employed in adopting the Rule failed to generate a record sufficient to support the optimistic conclusion that high-level and transuranic wastes would be isolated from the environment for the requisite number of centuries.[32] The court noted that the portion of the rule precluding inquiry into these matters was based on a few conclusory reassurances from a member of the Commission's staff who was not questioned or cross-examined.[33] That part of the Rule was therefore held to be arbitrary and capricious, and was set aside and remanded. We also held that in the absence of a valid generic rule, the environmental impact of fuel-cycle activities must be considered in individual licensing proceedings. Because the Commission had granted Vermont

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[27] 39 Fed. Reg. 14188 (1974).

[28] *Id.* at 14191.

[29] In re Vermont Yankee Nuclear Power Corp. (Vermont Yankee Nuclear Power Station), LPB-73-8, 6 A.E.C. 130 (1973).

[30] In re Vermont Yankee Nuclear Power Corp. (Vermont Yankee Nuclear Power Station), ALAB-179, 7 A.E.C. 159, 163 (1974).

[31] NRDC v. NRC, 547 F.2d 633 (D.C.Cir. 1976), *rev'd sub nom.* Vermont Yankee Nuclear Power Corp. v. NRDC, 435 U.S. 519 (1978).

[32] 547 F.2d at 653-54.

[33] 547 F.2d at 647-52.

Yankee's operating license without such consideration, we remanded the order granting that license to await the outcome of further generic proceedings.[34] These decisions were rendered July 21, 1976.

B. *The Supreme Court's Decision*

In April 1978, the Supreme Court reversed this court's decision to set aside the original Table S-3 Rule,[35] finding that we had overturned the Rule because of deficiencies in the Commission's rulemaking procedures.[36] The Court held that if an agency complies with the procedures required by statute, a rule may be struck down because of procedural shortcomings only in unusual circumstances.[37] The Supreme Court agreed, however, that the Rule should be vacated if it lacks support in the administrative record, and remanded the case to us "so that the Court of Appeals may review the rule as the Administrative Procedure Act provides."[38] That case, No. 74-

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[34] 547 F.2d at 641. On October 8, 1976, this court stayed its mandate in these actions. Due to the Supreme Court's decision, Vermont Yankee Nuclear Power Corp. v. NRDC, 435 U.S. 519 (1978), the mandate never issued.

[35] Vermont Yankee Nuclear Power Corp. v. NRDC, 435 U.S. 519 (1978).

[36] 435 U.S. at 541-42.

[37] 435 U.S. at 542-48.

[38] 435 U.S. at 549. The Supreme Court did not disturb this court's ruling that, in the absence of a valid generic rule, the environmental impact of the fuel cycle must be dealt with in individual licensing proceedings. 435 U.S. at 538-39. The Supreme Court also remanded our decision holding Vermont Yankee's operating license invalid. By the time of the Supreme Court's decision, that license had been reconsidered in light of the interim Rule. *See* TAN 40-60 *infra*. 435 U.S. at 535 n.14; In re Vermont Yankee Nuclear Power Corp. (Vermont Yankee Nuclear Power Station), ALAB-421, 6 N.R.C. 25 (1977). The validity of Vermont Yankee's license is the subject of No. 74-1385, which was originally consolidated

1586, is, therefore, among the four consolidated cases now before us.

The Supreme Court also noted that the Commission had promulgated an interim Rule pending the issuance of a final Rule. It stated that this court, on remand, could consolidate the challenge to the original Rule with the appeal from the interim rulemaking proceeding, which was already pending. The Court further noted that this court could decide those cases on the basis of an expanded record, which is what we have done.[39]

C. *The Interim Table S-3 Rule*

On October 18, 1976, in response to this court's decision but prior to the Supreme Court's remand, the Commission initiated proceedings to review the waste-management and disposal aspects of the Table S-3 Rule, and to develop a revised and adequately supported fuel-cycle rule.[40] The Commission announced that a special Task Force had completed a revised *Environmental Survey of the Reprocessing and Waste Management Portions of the LWR Fuel Cycle*,[41] and invited comments on the *Survey* and the revised Table S-3, both of which would constitute the basis of a final or interim rule.[42] Also in re-

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with No. 74-1586, but is now being held in abeyance pending decision in the present cases. *See* Order of Consolidation for Nos. 74-1586, 77-1448, 79-2110, and 79-2131, Feb. 11, 1980; Order Clarifying Application of Order of February 11, 1980 to No. 74-1385, March 12, 1980.

[39] 435 U.S. at 535 n.14. The parties to the present action have stipulated that this court "may consider the entire record in deciding the challenge to any of the orders under review." Stipulation filed February 29, 1980.

[40] 41 Fed. Reg. 45849 (1976).

[41] NUREG-0116, *supra* note 14.

[42] 41 Fed. Reg. 45849 (1976). A table entitled "Summary of Impacts of Reprocessing and Waste Management Per RRY

sponse to this court's ruling, the Commission had reconvened a licensing board to consider suspending the operating license of Vermont Yankee, which, by then, was fully operational.[43] The Commission suspended that proceeding, however, when it decided that an interim rule, similar to the original, could issue shortly.[44]

In announcing that it was reconsidering the Table S-3 Rule, the Commission stated:

> [T]here are still uncertainties in areas such as the effect of waste presence on repository stability; the probabilities and consequences of various types of intrusive acts by humans; the availability of data to be used in modeling studies; the design and regulatory actions needed to minimize possibilities of repository failure; projection of future societal habits and demography; and, finally, the relative importance of the various potential initiating events. Research programs are underway which should resolve most of these uncertainties over the next few years.[45]

Nonetheless, the *Survey* and proposed Table S-3 still provided that solidified high-level and transuranic wastes, which were to be buried in a permanent repository, would have no effect on the environment. Unlike the original Table, the revised Table S-3 did contain an entry for solidified high-level and transuranic wastes. It provided that 11 million curies of radiation would be re-

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[reference reactor year]," was reproduced in the notice. *Id.* at 45852 (1976). That table disaggregated Table S-3's list of environmental impacts, indicating the contribution of each stage of the back end of the fuel to the total impacts. It, therefore, represented a more detailed version of a revised Table S-3.

[43] *See* 41 Fed. Reg. 34707, 34709 (1976).

[44] In re Vermont Yankee Nuclear Power Corp. (Vermont Yankee Nuclear Power Station); CLI-76-18, 4 N.R.C. 471 (1976).

[45] 41 Fed. Reg. 45849, 45850-51 (1976).

leased from the solidified waste per reference reactor year. Under the "maximum effect" column, however, the Table simply stated "Buried at Federal Repository."[46] The materials referenced by the footnotes to the Table make clear that this meant that the radiation would remain wholly contained within the repository once the repository is sealed.[47]

The NRDC filed comments stating that the *Survey* and Table were based on only an assumption that technology could be developed to isolate long-term wastes from the environment, and that the consequences of the failure of such development were left unanalyzed. The NRDC's comments also stated that the numerical values in the Table failed to reveal the health effects of environmental impacts or the cumulative effects of the continuous creation of radioactive wastes.[48] In addition, the State of New York filed comments objecting to the NRC's failure to consider the economic feasibility of the projected waste-management and disposal methods.[49] The Commission staff and, ultimately the Commission, rejected all of these complaints and refused to modify the proposed rule.[50]

In March 1977, on the basis of the revised *Survey* and the comments received, the Commission promulgated an interim Table S-3 Rule,[51] which, as indicated in the Commission's notice, explicitly stated that releases

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[46] *See* note 8 *supra* (sample Table).

[47] NUREG-0116, *supra* note 14, at 2-31 n."f", 2-33.

[48] U.S. NUCLEAR REGULATORY COMM'N, PUBLIC COMMENTS AND TASK FORCE RESPONSES REGARDING THE ENVIRONMENTAL SURVEY OF THE REPROCESSING AND WASTE MANAGEMENT PORTIONS OF THE LWR FUEL CYCLE (NUREG-0116) B-96, B-102 (NUREG-0216, March 1977) [hereinafter cited as NUREG-0216].

[49] *Id.* at B-107.

[50] *Id.* at 3-5 to 3-7; 42 Fed. Reg. 13803 (1977).

[51] 42 Fed. Reg. 13803 (1977).

from the solidified high-level and transuranic wastes would remain buried in a repository and, therefore, have no effect on the environment.[52] Like the original Table S-3 Rule, the interim Rule stated that the environmental effects of the fuel cycle "shall be as set forth in Table S-3," and that "[n]o further discussion of such environmental effects shall be required."[53] The Commission amended the interim Rule in April 1978, however, to allow licensing boards to consider environmental impacts not specifically "addressed by the Table."[54]

In April 1977, the Commission issued an order directing the Appeal Board to reconsider the cost-benefit balances which had been struck in the licensing proceedings of Vermont Yankee and several other plants.[55] The following July, the Board ruled that the values in Table S-3 did not change the cost-benefit balance of the Vermont Yankee plant, particularly because the plant was already operating.[56] In connection with this reconsidera-

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[52] *See id.* at 13807.

[53] *Id.* at 13806.

[54] 43 Fed. Reg. 15613, 15617 (1978). This amendment was foreshadowed, to a limited degree, by a January 1977 Appeal Board ruling that, in an individual licensing proceeding, the discussion of health effects, such as that previously requested by the NRDC, was required when comparing a proposed nuclear power plant to the alternative of a coal-burning plant. In re Tennessee Valley Authority (Hartsville Nuclear Plant), ALAB-367, 5 N.R.C. 92 (1977).

[55] In re Vermont Yankee Nuclear Power Corp. (Vermont Yankee Nuclear Power Station), CLI-77-10, 5 N.R.C. 717 (1977). Initially, however, in promulgating the interim Rule, the Commission had simply terminated the Licensing Board's reconsideration of Vermont Yankee's license. 42 Fed. Reg. 13806 (1976).

[56] In re Vermont Yankee Nuclear Power Corp. (Vermont Yankee Nuclear Power Station), ALAB-421, 6 N.R.C. 25 (1977).

When Vermont Yankee and other facilities were licensed, it was anticipated that spent reactor fuel would be stored on

tion, the Board expressed concern over the proper interpretation of the Table S-3 entry for high-level and transuranic wastes, given the fact that the Commission openly admitted that the assumption of no environmental effect was uncertain.[57] The Board strongly implied that its

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site for only a brief period to allow cooling; thereafter, it would be shipped off site for reprocessing or permanent disposal. Plans for off-site reprocessing and storage had not materialized, however, and in 1977 President Carter suspended indefinitely all commercial reprocessing. 13 WEEKLY COMP. OF PRES. DOC. 506 (1977). Vermont Yankee's on-site storage capacity of 600 fuel assemblies would have been exhausted by 1977—and the plant forced to shut down in August 1978—had the utility not sought and received a license amendment from the Commission allowing it to increase its spent-fuel storage capacity to 2,000 assemblies. In re Vermont Yankee Nuclear Power Corp. (Vermont Yankee Nuclear Power Station), LBP-77-54, 6 N.R.C. 436 (1977). That license amendment would allow the plant to operate through 1987 without shipping waste to an off-site storage facility.

Intervenors protested that such a license amendment requires a formal EIS, but both the Licensing Board and the Appeal Board ruled that the amendment was "not a major Federal action that significantly affects the quality of the human environment." 6 N.R.C. at 445; In Re Northern States Power Co. (Prairie Island Nuclear Generating Plant), ALAB-455, 7 N.R.C. 41 (1978). The boards relied on the Commission's prior denial of NRDC's petition for rulemaking on the issue of waste disposal, *see* note 60 *infra*, as support for their finding that the Commission had "reasonable confidence" that waste disposal facilities would be available when needed. 7 N.R.C. at 49-51. On review of the Appeal Board decision, this court ruled that under the AEA, the Commission could make a finding of "reasonable confidence" only following a fact-finding proceeding. Minnesota v. NRC, 602 F.2d 412 (D.C. Cir. 1979). The court remanded the case to the Commission for it to reconsider its reasonable confidence in light of the ongoing Table S-3 rulemaking proceedings. In response, the Commission instituted a separate "Waste Confidence" proceeding. 44 Fed. Reg. 61372 (1979).

[57] In re Vermont Yankee Nuclear Power Corp. (Vermont Yankee Nuclear Power Station), ALAB-392, 5 N.R.C. 759,

interpretation of that aspect of the Table could alter the outcome of particular decisions.[58] Ultimately, however, the Appeal Board concluded that the Commission had intended it to assume that there would be no effluent releases from the permanent repository, once it is sealed.[59]

In No. 77-1448, the second of the four cases now before this court, NRDC challenges the interim Rule.[60]

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765 n.7 (1977); *see also* In re Vermont Yankee Nuclear Power Corp. (Vermont Yankee Nuclear Power Station), ALAB-421, 6 N.R.C. 25, 30-32 (Farrar concurring).

[58] 5 N.R.C. at 765 & n.7.

[59] 6 N.R.C. at 30-32 (Farrar concurring).

[60] NRDC petitioned for review of the interim Rule on May 13, 1977. On July 5, 1977, however, NRDC filed a Motion To Hold Petition For Review In Abeyance, which was granted. That motion was based on several events that could have materially altered the facts and law of the case, including the presidential decision of April 7, 1977, *see* note 56 *supra*, to defer indefinitely the reprocessing of spent fuel, and the then pending Supreme Court review of this court's previous decision. NRDC v. NRC, 547 F.2d 633 (D.C.Cir. 1976), *rev'd sub nom.* Vermont Yankee Nuclear Power Corp. v. NRDC, 435 U.S. 519 (1978).

At about the time that the interim Rule was under consideration, the NRDC petitioned the Commission to conduct a rulemaking on a related issue: whether the wastes from nuclear power reactors could be permanently disposed of without undue risk to public health and safety. NRDC argued that, until such a determination is made, the Commission has no authority under the Atomic Energy Act (AEA) to issue additional power-plant licenses. The Commission denied the petition without a hearing, ruling that the AEA did not make assured safe disposal a prerequisite for plant licensings. 42 Fed. Reg. 34391 (1977). The Commission contended that the AEA only required safe interim storage and reasonable confidence in an eventual permanent solution. The Commission cited the contemporaneous Table S-3 rulemaking, as well as work by the Energy Research and Development Administration—the agency responsible for waste management—as providing the confidence needed to continue licensing. *Id.* at

D. *The Final Table S-3 Rule*

In May 1977, following the adoption of the interim Rule, the Commission reopened hearings to determine whether the interim Rule should be made final or altered in any way.[61] The hearings employed some procedures not used in the original rulemaking, and participants were given an additional opportunity to comment on the Hearing Board's recommendations to the Commission.[62] The NRDC criticized the Rule for the failure of the numerical values to communicate either the uncertainties of underlying assumptions, or the health, cumulative, or socioeconomic effects of waste-management and disposal activities.[63]

The States of New York and Wisconsin again objected to the Commission's failure to analyze the economic viability of the proposed waste-management and disposal methods. The Commission staff initially argued that the economics of the proposed methods should not be considered.[64] The Hearing Board, however, and later the Commission, ordered that evidence concerning the economic feasibility of the proposed technologies be considered in the rulemaking.[65] The States of New York, Ohio, and Wisconsin submitted such evidence, criticizing the cost

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34393. The Second Circuit upheld the Commission's reading of the AEA, although it expressly distinguished the broad delegation under that statute from the more explicit requirements of NEPA. NRDC v. NRC, 582 F.2d 166, 172 (2d Cir. 1978). *Cf.* Minnesota v. NRC, 602 F.2d 412 (D.C. Cir. 1979) (fact-finding proceeding necessary prior to reaching "reasonable confidence" conclusion).

[61] 42 Fed. Reg. 26987 (1977).

[62] *See* 44 Fed. Reg. 45362, 45366-67 (1979).

[63] Closing Statement of the Natural Resources Defense Council, June 26, 1978, at 2-5, V JAS at 1364-67.

[64] First Round of Suggested Staff Questions and Comments on Scope of Proceeding, October 31, 1977, at 6-7, II JAS at 439-40.

[65] Commission's Order, February 9, 1978, IV JAS at 1254.

projections and the economic feasibility of the anticipated disposal methods.[66] In response, the Commission staff and industry groups submitted evidence in support of the cost estimates used.[67]

In July 1979, the Commission promulgated the final Table S-3 Rule.[68] The final Rule made only minor adjustments in the Table's numerical values and left unchanged the assumption that radiological effluents from solidified high-level and transuranic wastes would have no effect on the environment once sealed in a federal repository.[69] The Commission also stated its intention to add an explanatory narrative to Table S-3 to convey the significance of the numerical values.[70] In addition, the

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[66] *E.g.*, Supplementary Testimony of Dr. Irwin C. Bupp, II JAS at 662; Statement of Peter N. Skinner, September 30, 1977, III JAS at 1099.

[67] *E.g.*, Staff Testimony on Economic Data to Support the Feasibility of the S-3 Model, February 3, 1978, III JAS at 1195; Final Written Statement on Behalf of Commonwealth Edison, June 26, 1978, XI-1 to XI-39, II JAS at 763-801.

[68] 44 Fed. Reg. 45362 (1979).

[69] *See* note 8 *supra*; 44 Fed. Reg. 45362, 45369, 45373 (1979).

[70] The Commission stated:

> The rulemaking record makes clear that effluent release values, standing alone, do not meaningfully convey the environmental significance of uranium fuel cycle activities. The focus of interest and the ultimate measure of impact for radioactive releases are the resulting radiological dose commitments and associated health effects. To convey in understandable terms the significance of releases in the Table, the Hearing Board recommended that the modified Table be accompanied by an explanatory narrative promulgated as part of the rule. The recommended narrative would also address important fuel cycle impacts now outside the scope of the Table, including socioeconomic and cumulative impacts, where these are appropriate for generic treatment. The Commission has directed the NRC staff to prepare by October 1 such

Commission confirmed its intention that the Table should be supplemented by individual presentations on the health, socioeconomic, and cumulative effects of fuel-cycle activities, pending the adoption of such a narrative.[71]

As it had done before, the Commission noted the uncertainties regarding both the likelihood of finding a site for a permanent repository and the likelihood that the repository will perform as expected.[72] Nonetheless, the Commission explicitly rejected the option of expressing uncertainties in the Table S-3 Rule. The Commission stated:

> In view of the uncertainties noted regarding waste disposal, the question then arises whether these uncertainties can or should be reflected explicitly in the fuel cycle rule. The Commission has concluded that the rule should not be so modified. On the individual reactor licensing level, where the proceedings deal with fuel cycle issues only peripherally, the Commission sees no advantage in having licensing boards repeatedly weigh for themselves the effect of uncertainties on the selection of fuel cycle impacts for use in cost-benefit balancing. This is a generic question properly dealt with in this rulemaking as part of choosing what impact values should go into the fuel cycle rule. The Commission concludes, having noted that uncertainties exist, that for the limited purpose of the fuel cycle rule it is reasonable to base impacts on the assumption which the Commission believes the probabilities favor, *i.e.*, that bedded-salt repository

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a narrative, as described in more detail later in this notice. The narrative will be submitted for public comment in a further rulemaking.

Id. at 45862.

[71] *Id.*

[72] *Id.* at 45368 (citing IRG REPORT, *supra* note 14, at 42).

> sites can be found which will provide effective isolation of radioactive waste from the biosphere.[73]

Thus the Commission's final Rule, like its two predecessors, does not permit licensing boards to consider either the risk that permanent waste management facilities will not be developed or the risk that they will fail to perform as intended if they are developed. In addition, the Commission accepted the Hearing Board's recommendation and conclusion that the projected facilities were economically feasible because they were not "outlandishly expensive." [74]

In 79-2110, the State of New York challenges the final Rule on the ground that the Commission's finding of economic feasibility is arbitrary and capricious. In 79-2131, the NRDC challenges the final Rule because it inadequately discloses, and fails to allow proper consideration of, the uncertainties underlying the environmental impacts embodied in the final Table.

II. Standards of Review

As the Supreme Court has stated, we must review the Table S-3 Rule under the standards provided in the Administrative Procedure Act (APA).[75] The applicable provision of the APA is section 706(2)(A), which provides that a reviewing court shall "hold unlawful

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[73] *Id.* at 45369 (footnote omitted).

[74] *Id.* at 45367. The Commission also agreed with the Hearing Board that the costs of decontamination were site specific and not within the Rule. *Id.* at 45367 n.18.

[75] Vermont Yankee Nuclear Power Corp. v. NRDC, 435 U.S. 519, 549 (1978). We are here reviewing the original, interim and final Rules on their faces—not the procedures that produced them. We also do not consider whether nuclear power plants are "good" or "bad." Congress has left it up to the Commission to determine whether, in individual instances, the benefits of nuclear power outweigh the costs. All we consider is whether the Commission has complied with the mandates of the APA and NEPA in performing this task.

and set aside agency action, findings and conclusions found to be—arbitrary, capricious, an abuse of discretion, or otherwise not in accordance with law." [76] In this case, both the "arbitrary and capricious" and the "not in accordance with law" standards are appropriate. Under the latter standard, we must determine whether the Table S-3 Rule, as applied to individual licensing decisions, violates NEPA,[77] while under the "arbitrary and capricious" standard, our task is to "consider whether the decision was based on a consideration of the relevant factors and whether there has been a clear error of judgment." [78] Of course, other laws must give content to the phrase "relevant factors." Because the Table S-3 Rule governs the preparation of environmental impact statements for individual nuclear reactors, NEPA provides the relevant factors that the Commission was required to consider in formulating the Rule. Therefore, there is an area of overlap between the "arbitrary and capricious" standard and the "in accordance with law" standard.

III. NEPA

It is well settled that the licensure of a nuclear power plant constitutes a "major Federal action[] significantly affecting the quality of the human environment." [79] Therefore, there can be no doubt that the Commission

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[76] 5 U.S.C. § 706(2)(A) (1976).

[77] *See* Calvert Cliffs' Coordinating Committee, Inc. v. AEC, 449 F.2d 1109 (D.C.Cir. 1971) (review of rules implementing NEPA to determine whether they complied with NEPA).

[78] Citizens to Preserve Overton Park, Inc. v. Volpe, 401 U.S. 402, 416 (1971); Bowman Transportation, Inc. v. Arkansas-Best Freight System, Inc., 419 U.S. 281, 285-86 (1974).

[79] 42 U.S.C. § 4332(2)(C) (1976). *See* Vermont Yankee Nuclear Power Corp. v. NRDC, 435 U.S. 519, 538-39 (1978).

must comply with section 102(2)(C) of NEPA[80] prior to licensing such a plant. That section provides:

> The Congress authorizes and directs that, to the fullest extent possible . . . all agencies of the Federal Government shall . . . include in every recommendation or report on proposals for legislation and other major Federal actions significantly affecting the quality of the human environment, a detailed statement by the responsible official on—
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> (i) the environmental impact of the proposed action, [and]
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> (ii) any adverse environmental effects which cannot be avoided should the proposal be implemented, [and]
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> (v) any irreversible and irretrievable commitments of resources which would be involved in the proposed action should it be implemented.

Furthermore, as the Supreme Court has stated,

> [i]t is hard to argue that [nuclear wastes] do not constitute "adverse environmental effects which cannot be avoided should the proposal be implemented," or that by operating nuclear power plants we are not making "irreversible and irretrievable commitments of resources."[81]

Therefore, the Commission must fully consider and disclose the environmental impact of nuclear wastes during the course of its decisions to license nuclear power plants.[82]

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[80] 42 U.S.C. § 4332(2)(C) (1976).

[81] Vermont Yankee Nuclear Power Corp. v. NRDC, 435 U.S. 519, 539 (1978).

[82] *See, e.g.*, Trout Unlimited v. Morton, 509 F.2d 1276, 1282 (9th Cir. 1974); Environmental Defense Fund, Inc. v. Corps of Engineers, 325 F.Supp. 749, 759 (E.D.Ark. 1971).

It is well recognized that section 102(2)(C) of NEPA has a dual function: Its first function is "to inject environmental considerations into [federal agencies'] decisionmaking process[es];" [83] and its second function is to inform the public of the nature of the agencies' decisions, and to "inform the public that [agencies have] considered environmental concerns in [their] decisionmaking process[es]." [84] With respect to these statutory purposes, the Supreme Court has stated, and recently reiterated,[85] that "[t]he thrust of § 102(2)(C) is . . . that environmental concerns be integrated into the very process of agency decisionmaking. The 'detailed statement' it requires is the outward sign that the environmental values and consequences have been considered during the planning stage of agency actions." [86] In *Calvert Cliffs' Coordinating Committee, Inc. v. AEC*,[87] one of the first cases decided under NEPA, this court analyzed these aspects of the Act in further detail. We stated that "[c]ompliance to the *'fullest'* extent possible would seem to demand that environmental issues be considered at every important stage in the decisionmaking process concerning a particular action—at every stage where an overall balancing of environmental and nonenvironmental factors is appropriate and where alterations might be made in the proposed action to minimize environmental costs." [88] Thus, decisionmaking under NEPA must be organized in such a manner that all of the reasonably foreseeable environmental effects of a proposed action enter into an

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[83] Weinberger v. Catholic Action of Hawaii/Peace Education Project, 50 U.S.L.W. 4027, 4028-29 (Dec. 1, 1981).

[84] *Id.*

[85] *Id.*

[86] Andrus v. Sierra Club, 442 U.S. 347, 350 (1979) (footnote omitted).

[87] 449 F.2d 1109 (D.C.Cir. 1971).

[88] 449 F.2d at 1118.

agency's decision to take the action.[89] The environmental impact statement, the centerpiece of NEPA's procedural requirements, both facilitates and provides a record of this decisionmaking process. As we noted in *Calvert Cliffs*, two related purposes of the EIS are to provide evidence that the mandated decisionmaking process has taken place, and to "allow[] those removed from the initial process to evaluate and balance the [environmental] factors on their own."[90] The decisionmaking structure mandated by section 102(2)(C) is not inherently flexible, nor are the particular requirements that it entails discretionary.[91] It is the role of the courts to ensure that agencies comply with these provisions of NEPA.[92]

The NRC's promulgation of the Table S-3 Rule represents both an attempt to implement, and a limitation on other means of implementing, these aspects of NEPA.[93] The validity of the Rule, therefore, turns

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[89] Under NEPA's Rule of Reason, an agency must consider only "reasonably foreseeable" environmental impacts. *See, e.g.*, Scientists' Institute for Public Information, Inc. v. AEC, 481 F.2d 1079, 1092 (D.C.Cir. 1973); Carolina Environmental Study Group v. United States, 510 F.2d 796, 798 (D.C.Cir. 1975).

[90] 449 F.2d at 1114.

[91] 449 F.2d at 1114, 1115.

[92] It is well accepted that courts must exercise heightened review of agencies' compliance with section 102(2)(C) of NEPA. *See* NRDC v. SEC, 606 F.2d 1031, 1048 (D.C.Cir. 1979); Scientists' Institute for Public Information, Inc. v. AEC, 481 F.2d 1079, 1094 (D.C.Cir. 1973); Calvert Cliffs' Coordinating Committee, Inc. v. AEC, 449 F.2d 1109, 1114 (D.C. Cir. 1971). *See also* W. ROGERS, ENVIRONMENTAL LAW 716-17 (1977) (procedural requirements of NEPA "enforced with a vengence").

[93] The Commission does not argue that the environmental impact of fuel-cycle activities is insignificant, nor does it

largely on whether the decisionmaking structure it mandates conforms to the procedures, and thereby poses no obstacles to the substantive calculus, required by NEPA.[94] Specifically, we must determine whether the Table S-3 Rule (1) violates NEPA; or (2) is arbitrary and capricious, given the considerations made relevant by NEPA.

IV. Analysis

Petitioners, the NRDC and the State of New York, challenge the Table S-3 Rules on three grounds. First, the NRDC argues that the original, interim and final versions of the Table S-3 Rule are arbitrary and capricious and not in accordance with NEPA because they preclude proper consideration and disclosure of uncertainties that underlie the Tables' numerical values.

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appear that such an argument could legitimately be made. The ASLAB has stated that

> although the adverse environmental consequences of the fuel cycle attributable to individual nuclear generating plants are small, they are not without any weight. . . . [I]n a close situation they might throw the cost/benefit balance against issuing a construction permit. This opens the distinct possibility that construction permits would be vulnerable to judicial challenge under NEPA if issued after hearings which did not take relevant and potentially significant adverse environmental factors into account.

In re Potomac Electric Power Co. (Douglas Point Nuclear Generating Station, Units 1 and 2), ALAB-218, 8 A.E.C. 79, 87 (1974). This view was approved by the Commission, which noted that excluding fuel-cycle effects in a close case would place the boards in the almost untenable posture of refusing to consider known relevant environmental factors which could possibly affect the cost-benefit balance. In re Philadelphia Electric Co., *et al.* (Peach Bottom Power Station, Units 2 and 3), CLI-74-32, 8 A.E.C. 217, 220 (1974).

[94] The issues in *Calvert Cliffs* were presented in a posture similar to that of this case. In that case, as in this, we reviewed regulations that the AEC had promulgated to govern the implementation of NEPA.

Second, the NRDC argues that the original and interim Table S-3 Rules are arbitrary and capricious and not in accordance with NEPA because they preclude proper consideration and disclosure of the tangible environmental effects of the waste created by nuclear power plants. Finally, the State of New York argues that the release levels projected in the final Table S-3 Rule are based on a finding of economic feasibility that was arbitrary and capricious.

We conclude that the Table S-3 Rules are arbitrary and in violation of NEPA because they fail to allow for consideration of uncertainties underlying the assumption that no radiological effluents will be released into the biosphere once wastes are sealed in a permanent repository. Similarly, we conclude that the original Rule and the interim Rule, prior to amendment, are arbitrary and in violation of NEPA in their failure to allow consideration of health, socioeconomic, and cumulative effects of fuel-cycle activities. We also conclude, however, that the Commission's finding that the predicted waste-management and disposal methods would be economically feasible was neither arbitrary nor capricious.

A. *The Zero-Release Assumption and Uncertainty Over Permanent Storage*

The original, interim, and final Rules all prohibit licensing boards from considering the uncertainties surrounding the Table S-3 Rules.[95] In particular, no challenges were allowed to the assumption that a suitable final repository site would be found, constructed, and would operate flawlessly.[96] The assumption underlying

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[95] *See* pp. 17, 22, 27-28 *supra*; In re Potomac Electric Power Co. (Douglas Point Nuclear Generating Station), ALAB-218, 8 A.E.C. 79, 88-90 (1974); In re Vermont Yankee Nuclear Power Corp. (Vermont Yankee Nuclear Power Station), ALAB-421, 6 N.R.C. 25, 30-32 (1977) (Farrar concurring).

[96] Contrary to the implication of Judge Wilkey's dissent, *see, e.g.*, Wilkey op. at 34, 42, 55-64, the NRDC does not

Table S-3 that no radiological effluents will be released from the permanent repository, once the repository is sealed, can be interpreted in either of two ways: It can be read as a factual finding, or, as a decisionmaking device by which the Commission retains exclusive responsibility for considering the uncertainties concerning long-term waste disposal. Particularly in the interim and final Rules, it appears that the latter is the correct characterization.[97] Nonetheless, for the sake of complete-

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challenge, and we do not decide, the reasonableness of the Commission's conclusion that the probabilities favor the zero-release assumption. Rather, the NRDC objects to the fact that the Commission has not factored the consideration of uncertainties into the licensing process in such a manner that they can potentially affect the outcome of any decision to license a plant.

[97] In the original Rule's Statement of Consideration, the Commission made no reference to any uncertainty underlying its conclusion that a permanent repository would be built. In contrast, in the Statements of Consideration for the interim and final Rules, the Commission repeatedly acknowledged the uncertainties involved in its "judgments." *See* note 118 *infra*. The Commission nonetheless stated that there was "no advantage in having licensing boards repeatedly weigh for themselves the effect of uncertainties on the selection of fuel cycle impacts for use in cost-benefit balancing." 44 Fed. Reg. 45362, 45369 (1979). The Commission believed that the

> "question [was] properly dealt with in this rulemaking as part of choosing what impact values should go into the fuel cycle rule. The Commission conclude[d], [that] having noted that uncertainties exist, that for the limited purpose of the fuel cycle rule it [was] reasonable to base impacts on the assumption which the Commission believe[d] the probabilities favor."

Id. Commissioner Bradford, writing separately, stated that he thought

> "that the Commission [had gone] too far in terming its assumption that a 'bedded salt repository or its equivalent will be found' to be a 'judgment'. [Instead,] little more can be said by a prudent regulatory agency at this time in the face of this record and the general uncertainty

ness, we review the validity of the zero-release assumption under each interpretation.[98]

1. *The Zero-Release Assumption as a Factual Finding*

As stated in Part II, above, a reviewing court must set aside an agency finding as arbitrary if it determines that the finding is not based upon consideration of relevant factors or if it is based on a clear error of judgment.[99] The "relevant factors" in this case are those whose consideration is mandated by NEPA.

Among the environmental costs that an agency must consider under section 102(2)(C) are significant environmental risks—probabilities or possibilities of environmental damage.[100] Such risks may be present due to the

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than that the direction of current federal programs makes a bedded salt repository a responsible working assumption for NEPA purposes."

Id. at 45373 (Separate Views of Commissioner Bradford). *See* p. 43 *infra.*

[98] Contrary to Judge Wilkey's assertions, *see, e.g.*, Wilkey op. at 48, our conclusions do not turn on a characterization of the zero-release assumption as a finding of fact. *See* pp. 42-49 *infra.*

[99] *See* pp. 28-29.

[100] *See, e.g.*, Izaak Walton League of America v. Marsh, 655 F.2d 346, 377 (D.C.Cir.), *cert. denied sub nom.* Atchison, Topeka & Santa Fe Railway Co. v. Marsh, 102 S. Ct. 657 (1981); Alaska v. Andrus, 580 F.2d 465, 473 (D.C.Cir.), *vacated in part sub nom.* Western Oil & Gas Assoc. v. Alaska, 439 U.S. 922 (1978); Concerned About Trident v. Rumsfeld, 555 F.2d 817, 830 (D.C.Cir. 1976).

Risk, in this context, refers to the product of the environmental damage that could occur and the probability of its occurrence. Thus, an environmental risk can be high if the probability is high that damage will occur, even if the damage itself would not be terribly severe. Alternatively, an environmental risk can be significant if the probability is low that damage will occur, but the possible damage, should it occur, would be severe. Thus, even if the probability that environmental damage will occur is very low, the risk is nonetheless

underlying randomness of nature. Or they may be due to human uncertainty over either the character of both random and nonrandom phenomena or the ability of future technology to cope with those phenomena. Regardless of the source, environmental risks are environmental costs that must be factored into the NEPA calculus.[101] They must also be included in an EIS. Where

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significant if the potential damage is sufficiently severe. These risks are, therefore, of the same character as other environmental damage costs and, Judge Wilkey's dissent notwithstanding, Wilkey op. at 56, they must be considered *in the NEPA inquiry*. *See*, Ethyl Corp. v. Environmental Protection Agency, 541 F.2d 1, 25 n.52 (D.C.Cir. 1976) (en banc), *cert. denied sub nom.* E.I. DuPont de Nemours & Co. v. Environmental Protection Agency, 426 U.S. 941 (all environmental costs involve some degree of uncertainty); Carolina Environmental Study Group v. United States, 510 F.2d 796, 799 (D.C.Cir. 1975) (it is necessary "to consider the probabilities as well as the consequences of certain occurrences in assessing [an action's] environmental impact").

[101] When confronting a set of uncertain environmental effects, or an environmental risk that is known, an agency's goal should be to trace each reasonably foreseeable contingency and determine, first, the likelihood of its occurring, and second, the environmental damage that it would entail should it occur. Of course, precision in this context can only be the ideal, and the detail with which an agency must consider and disclose the likelihood and nature of each contingency is somewhat flexible. If a contingency is not expected to entail a serious environmental risk less detail is required. *See, e.g.*, Izaak Walton League of America v. Marsh, 655 F.2d 346, 377 (D.C.Cir.), *cert. denied sub nom.* Atchison, Topeka & Santa Fe Railway Co. v. Marsh, 102 S. Ct. 657 (1981). Alternatively, an agency may evaluate an uncertain environmental effect by considering and disclosing a worst-case scenario along with an estimation of the probability that the scenario will occur. *See* North Slope Borough v. Andrus, 642 F.2d 589, 605 (D.C.Cir. 1980); 40 C.F.R. § 1502.22 (1981). At the outset of the NEPA inquiry, however, a federal agency bears the obligation to seek information concerning the environmental consequences of proposed actions. Alaska v. Andrus, 580 F.2d 465, 473 (D.C.Cir. 1978), *vacated, in part, sub nom.* Western Oil & Gas Assoc. v. Alaska, 439 U.S. 922 (1978); Concerned About Trident v. Rumsfeld, 555 F.2d 817 (D.C.Cir. 1977).

such risks are attributable to a lack of knowledge, the agency can be asked to do no more than to reveal that which it knows and that which it does not know. It may not be permitted, however, to do any less.[102]

An agency could state in an EIS, as a matter of factual prediction, that a particular environmental effect will not have to be endured as a result of a proposed action. Of course, if it believes that to be the case, it can omit entirely any discussion of the would-be effect. Similarly, an agency could provide, by generic rule, that a particular environmental effect will not be caused by a class of actions, and that the effect should not be addressed in individual environmental impact statements. Because the risk of an environmental effect is the overriding "relevant factor" that an agency must consider in making such a factual finding, the agency may treat an environmental effect in this manner only if it finds that there is no significant risk that the environmental effect will occur. It may not do so if it finds only that the effect is unlikely to occur. Otherwise, NEPA's requirement that agencies consider and disclose uncertainty would be subverted. When faced with uncertainty concerning an environmental effect, an agency could evade its obligations under NEPA simply by finding that the effect will not occur. Thus, in the context of compliance with NEPA's procedural requirements, a court must interpret an agency's finding of no environmental effect as a finding that there is no significant risk of an environmental effect.

It is against that background that we review the Commission's finding that nuclear wastes that are sealed in a permanent repository will have no impact on the environment. When read as a finding that such wastes pose no

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[102] *See, e.g.*, Alaska v. Andrus, 580 F.2d 465, 473 n.36 (D.C. Cir. 1978), *vacated, in part, sub nom.* Western Oil & Gas Assoc. v. Alaska, 439 U.S. 922 (1978); Scientists' Institute for Public Information, Inc. v. AEC, 481 F.2d 1079, 1092 (D.C. Cir. 1973).

significant risk of environmental damage, we conclude that the finding represents a "clear error in judgment." [103]

In each version of the Table S-3 Rule, the Commission based its zero-release assumption on a prediction that technology would be developed by which to isolate long-lived wastes from the biosphere indefinitely. In the *Environmental Survey*,[104] which constituted the technical basis of the original Table S-3, the Commission staff reported that "[i]t was planned to construct a Federal repository in a salt mine for long-term geological storage of solid high-level wastes by the mid-1970's. However, subsequent events have deferred the site selection and construction of such a facility." [105] The plan at that time, therefore, was to build a Retrievable Surface Storage Facility (RSSF) in which to store the wastes until a permanent repository became available. The *Environmental Survey* said no more than that the permanent repository that would be developed "is intended to isolate the waste from man and the biosphere." [106] A few years later, in the report that formed the basis of the interim and final Rules, the Commission staff continued to assume that a bedded-salt repository could be developed, but noted that other systems were also under consideration.[107] The other systems included the use of alternative geological media for isolation, and the "eliminat[ion of] portions of the wastes from existence on earth." [108] The Commission still had not worked out the technological details of any permanent disposal techniques. Nonetheless, it concluded that a system would be developed that would fully protect the envi-

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[103] Bowman Transportation, Inc. v. Arkansas-Best Freight, Inc., 419 U.S. 281, 285 (1974); Citizens to Preserve Overton Park, Inc. v. Volpe, 401 U.S. 402, 419 (1971).

[104] WASH-1248, *supra* note 23.

[105] *Id.* at G-6 to G-7.

[106] *Id.* at G-7.

[107] NUREG-0116, *supra* note 14, at 4-71 to 4-73.

[108] *Id.* at 4-72.

ronment. Until such a system is developed, the Commission still plans to store waste in an RSSF.[109]

Scientists with the United States Geological Survey testified to the technical uncertainties surrounding the zero-release assumption.[110] Similarly, the *Report to the President by the Interagency Review Group on Nuclear Waste Management*[111] pointed out that risk assessments "based on idealized repository characteristics . . . are subject to significant uncertainties,"[112] and concluded that the "zero release of radionuclides [from a permanent repository] cannot be assured."[113] In addition, the record indicates that serious concerns were raised over the likelihood of developing the human institutions or political consensus necessary to establish and maintain the hypothesized facilities.[114] The *IRG Report* noted, in fact, "that the resolution of institutional issues may well be more difficult than finding solutions to remaining technical problems."[115] Moreover, even the Commission's own staff recognized that there were many uncertainties surrounding the assumption that a permanent repository could be developed that would fully contain the effluents emitted from high-level and transuranic wastes.[116]

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[109] *Id.* at 4-29. The present status of the RSSF is also, at best, uncertain. *See* OFFICE OF MANAGEMENT AND BUDGET, MAJOR THEMES & ADDITIONAL DETAILS, FISCAL YEAR 1983, at 160 (1982); *Vepco Says Crisis Near in Used Nuclear Fuel Storage*, Washington Post, March 1, 1982, at A1 col. 2.

[110] Transcript of Hearing at 729-30, II JAS at 622-23.

[111] IRG REPORT, *supra* note 14. This report was entered in the record in draft form and discussed in an oral presentation. *See* 44 Fed. Reg. 45362, 45368 n.24 (1979).

[112] IRG REPORT, *supra* note 14, at 45.

[113] *Id.* at 17.

[114] Statement of Todd R. LaPorte, Oct. 3, 1977, I JAS at 393; Statement of Dr. Terry Lash, Oct. 3, 1977, II JAS at 437.

[115] IRG REPORT, *supra* note 14, at 87.

[116] NUREG-0116, *supra* note 14, at 4-94. *See* p. 20 *supra*.

There is no need, however, to comb the record further for evidence of uncertainty, for the Commission itself has explicitly—although somewhat belatedly—acknowledged its presence. In its Statement of Consideration for the final Rule, "the Commission note[d] and agree[d] . . . that areas of uncertainty remain regarding both the likelihood of finding a site and the probability that it will perform as expected." [117] The Commission nevertheless accepted its staff's zero-release assumption, stating that the staff's conclusion that there would be no release from the sealed repository had a "reasonable basis." Moreover, revealing even more of the uncertain nature of its judgment, the Commission concluded that the evidence, although "tentative" and general in nature, "favors the view that suitable sites can be found." [118]

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[117] 44 Fed. Reg. 45362, 45368 (1979) (footnote omitted).

[118] *Id.* From the time it proposed the original Rule through its promulgation of the final Rule, the Commission became increasingly candid in its acknowledgement of uncertainties underlying permanent waste disposal. In promulgating the original Rule, the Commission referred to no uncertainty. In promulgating the interim Rule, however, the Commission "observed that there [were] gaps in the information needed for detailed assessment of waste management and disposal technology." 42 Fed. Reg. 13803, 13805 (1977). Nevertheless, the Commission believed that such uncertainties did not prevent it "from making an informed and reasoned judgment . . . regarding the environmental impacts which may flow from waste management and reprocessing activities." *Id.* Even more candidly, in the final rulemaking, the Commission stated that it was its "judgment that a suitable bedded-salt repository site or its equivalent will be found, but the Commission note[d] . . . that areas of uncertainty remain regarding both the likelihood of finding a site and the probability that it will perform as expected." 44 Fed. Reg. 45362, 45368 (1979) (footnote omitted). The Commission found that its staff's assumption that there would be no release of effluents from a sealed repository was "afford[ed] a reasonable basis" by evidence that was "tentative but favorable." *Id.* The Commission was convinced that "the general evidence [presented], coupled with the absence of any strong argument that a site

The evidence in the record and the Commission's own recent statements indicate the existence of such uncertainty concerning permanent disposal of high-level and transuranic wastes that the zero-release assumption, taken as a finding of fact, cannot stand. If read as a finding of no significant risk, which we acknowledge may not have been its intent, the zero-release assumption represents a self-evident error in judgment. Therefore, we conclude that the finding is arbitrary and capricious.

2. *The Zero-Release Assumption as a Decisionmaking Device*

As stated above, the Commission's zero-release assumption is probably characterized better as a decisionmaking device than as a finding of fact, particularly in the interim and final Rules. By instructing licensing boards to assume that nuclear waste will have no impact on the environment once it is sealed in a repository, the Table S-3 Rule has served to allocate to the Commission sole responsibility for considering the risk that long-lived wastes will not be disposed of with complete success. Under that decisionmaking scheme, the Commission considered the possibility of unsuccessful isolation of wastes prior to promulgating the Table S-3 Rule. The Rule itself represents the Commission's statement that it has done so, and that licensing boards should go forward licensing plants without duplicating its effort.

Just as the Commission avoided describing the zero-release assumption as a finding of fact, it did not describe the assumption in precisely these terms either. In more recent years, however, the Commission has, at various times, seemed to indicate that this is essentially its view of the assumption. For instance, in its Statement of Consideration for the Final Rule, the Commission stated:

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cannot be found, *probably affords* as strong a record as can be made on the issue until a specific site has been thoroughly investigated and found to be suitable." *Id.* (emphasis added).

> In view of the uncertainties noted regarding waste disposal, the question then arises whether these uncertainties can or should be reflected explicitly in the fuel cycle rule. The Commission has concluded that the rule should not be so modified. On the individual reactor licensing level, where the proceedings deal with fuel cycle issues only peripherally, the Commission sees no advantage in having licensing boards repeatedly weigh for themselves the effect of uncertainties on the selection of fuel cycle impacts for use in cost-benefit balancing. This is a generic question properly dealt with in this rulemaking as part of choosing what impact values should go into the fuel cycle rule. The Commission concludes, having noted that uncertainties exist, that for the limited purpose of the fuel cycle rule it is reasonable to base impacts on the assumption which the Commission believes the probabilities favor, *i.e.*, that bedded-salt repository sites can be found which will provide effective isolation of radioactive waste from the biosphere.[119]

Our inquiry, therefore, must focus on whether the decisionmaking device of the Rule—including the Commission's investigation, analysis, and deliberation prior to the Rule's promulgation—has provided the type of consideration and disclosure of uncertainties that NEPA requires.

In general, an agency in the position of the Commission is free to implement NEPA through generic rulemaking. If certain types of environmental costs are common to a class of actions, NEPA does not require that an agency engage in duplicative and possibly inconsistent individual determinations, but allows it, in the alternative, to conduct a single rulemaking to determine generic values to be considered together with case-specific costs and benefits in individual proceedings.[120] Similarly, if

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[119] 44 Fed. Reg. 45362, 45369 (1979) (footnote omitted). *See* note 97 *supra*.

[120] *See* Ecology Action v. AEC, 492 F.2d 998, 1002 (2d Cir. 1974); Note, *The Use of Generic Rulemaking to Resolve En-*

there are both costs and benefits common to a class of individual actions, an agency is free, not only to determine generic values for those costs and benefits, but also to weigh the costs and benefits against each other to produce a generic "net value." To the extent that certain costs and benefits cannot be compared on a single scale, the generic determination of net value is necessarily more complex. It may involve instructing case-specific decisionmakers to insert fictional values into their cost-benefit analyses. A generic rule might be promulgated, for instance, designating that certain entries on one side of an individual actions' ledger should be treated as zero, or nonexistent, and assigning offsetting values to certain entries on the other side of the ledger. The agency may even determine that certain classes of generic costs and benefits so balance each other that both can be treated as zero for purposes of individual decisions. In the abstract, such generic structuring of individual decisionmaking is acceptable as long as it is based on the agency's reasoned judgments about how the generic costs and benefits weigh against each other.[121] In the course of such a generic rulemaking, however, the agency must consider and disclose the actual environmental effects it has assessed in a manner that will ensure that the overall process, including both the generic rulemaking and the individual proceedings, brings those effects to bear on decisions to take particular actions that significantly affect the environment. If the overall decisionmaking process allows for this type of consideration—which is precisely that described in *Calvert Cliffs*[122]—the agency may then direct case-specific decisionmakers to abide by the generic rule, and thereby preclude their reevaluation of either the underlying determinations of costs and benefits or the

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vironmental Issues in Nuclear Power Plant Licensing, 61 VA. L. REV. 869 (1975).

[121] We express no view as to whether this type of generic balancing could be done in the context of this case.

[122] 449 F.2d 1109, 1118 (D.C.Cir. 1971). *See* pp. 31-32 *supra*.

process by which those costs and benefits were assessed against each other.

Under the Table S-3 Rule, licensing boards consider virtually all factors relevant to the construction and operation of a nuclear power plant. The zero-release assumption, however, excludes from their consideration two factors: 1) uncertainty concerning the integrity of the permanent repository, if such a repository is ever built; and 2) uncertainty over whether and when such a repository, or equivalent system of disposal, will be developed. These uncertainties reflect two environmental costs of licensing a plant. The first cost is the risk that wastes created by the plant will eventually damage the environment by emitting radiological effluents from a faulty permanent repository. The second cost is the risk that waste created by the plant will have to remain in another type of repository—possibly on site[123]—and emit radiological

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[123] At this point, the temporary RSSF has not been built. *See* note 109 *supra*. Once it is built, the uncertainty over the development of a permanent repository translates into a possibility that wastes will remain indefinitely at the RSSF. Prior to the point at which the RSSF is built, however, that uncertainty translates into the possibility that the wastes will remain either at reprocessing plants or at the power plants themselves. Similarly, uncertainty concerning the development of the RSSF and of reprocessing plants gives rise to the possibility that wastes will have to remain in individual power plants', spent-fuel pools. To the extent that any of these possibilities entails significant risks, those risks must be factored into the NEPA calculus. If the risks are generic, they can be assessed, and possibily weighed against generic benefits, in generic rulemaking proceedings. If they are site-specific, however, they must be assessed with particular reference to the relevant site, and balanced along with other site-specific costs against site-specific benefits. *Cf.* Minnesota v. NRC, 602 F.2d 412 (D.C.Cir. 1979) (before allowing expansion of on-site repositories, NRC must examine possibility that spent fuel will remain on site due to lack of temporary or permanent off-site repositories); *Storage and Disposal of Nuclear Waste*, 44 Fed. Reg. 61373 (1979) (generic rulemaking initiated in response to *Minnesota*).

effluents prior to permanent disposal, if such disposal ever comes about. Hence, the zero-release assumption prevents licensing boards from considering two environmental costs.

The Commission argues that its consideration and disclosure of these costs prior to promulgating the Rule was sufficient under NEPA, and that the licensing boards need not reconsider them. We disagree. Although the Commission did consider these uncertainties, it did not do so in a manner that would allow licensing decisions to be affected—either directly or indirectly—by the risk that nuclear waste will not be successfully isolated from the environment indefinitely. After recognizing that there are uncertainties concerning the permanent storage of nuclear wastes, the Commission simply ruled that licensing decisions should be made on the basis of cost-benefit analyses that omitted the costs represented by those uncertainties. It did not rule that the costs were insignficant,[124] nor did it rule that they were outweighed by generic benefits that would also be excluded from licensing boards' consideration. In effect, therefore, the Commission directly contravened NEPA's requirement that environmental costs be considered "at every stage where an overall balancing of environmental and nonenvironmental factors is appropriate."[125] The risks entailed by the possible failure to develop a successful waste-disposal system were never part of any "balancing." They were considered alone, in a vacuum, and then excluded from the licensing boards' balancing. The process that began with the proposal of the Table S-3 Rule does not allow the uncertainties concerning permanent storage to play a role in the ultimate licensing decision. That omission, and hence, the Rule, which causes it, constitutes a blatant violation of NEPA.

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[124] *See* note 93 *supra* (rule of reason); pp. 38-41 *supra* (Commission recognition of uncertainties involved).

[125] Calvert Cliffs' Coordinating Committee, Inc. v. AEC, 449 F.2d 1109, 1118 (D.C.Cir. 1971).

In arguing that it adequately considered the uncertainties surrounding long-term storage, the Commission emphasizes the fact that these uncertainties represent generic costs.[126] The Commission recognizes that cost-benefit balances differ among individual plants and that these uncertainties are relevant costs, particularly if a plant's cost-benefit balance is close.[127] Nonetheless, the Commission asserts that "[it remains] a generic question how to weigh these uncertainties [in individual cases]." [128] To the extent that the Commission is arguing that the uncertainties can be assessed generically, and that the attendant risks can be measured generically, we agree. As we have stated above, however, the Commission cannot find the environmental cost represented by the uncertainties to be zero unless their cost is, in fact, zero.[129] Similarly, although the Commission can assess generic costs in a generic rulemaking, it must, in some manner, factor its assessment into ultimate decisions to license plants.[130] One way in which the Commission could do so would be to follow the course that it has taken with respect to other environmental costs of licensing nuclear power plants: It could assess and evaluate the uncertainties and attendant risks, and instruct licensing boards to consider and disclose them in a uniform manner. To the extent that the Commission is arguing, however, that generic costs need not be considered at all within the context of balancing the costs and benefits of licensing decisions, we strongly disagree. The fact that certain environmental costs can be assessed generically does not

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[126] NRC Brief at 36-38.

[127] *See* In re Vermont Yankee Nuclear Power Corp. (Vermont Yankee Nuclear Generating Station), ALAB-421, 6 N.R.C. 25, 30-32 (1977) (Farrar concurring).

[128] NRC Brief at 37.

[129] *See* p. 41 *supra*.

[130] *See* pp. 43-45 *supra*.

imply that they can be excluded entirely from the balancing process that must precede an agency's decision to take a major action.[131]

The Commission also argues that its disclosure of uncertainties in its Statements of Consideration and in its staff reports, satisfies NEPA's requirement of a "detailed statement." We recognize that the NRC, particularly in promulgating the final Rule, has disclosed the nature of many of the uncertainties surrounding the storage of long-lived wastes.[132] NEPA, however, requires an agency to do more than to scatter its evaluation of environmental damage among various public documents. As stated above, an agency must disclose environmental costs—including uncertainties concerning such costs—in a manner that proves to the public that the agency has properly considered the environmental costs of its action.[133] In this case, because the Commission has not properly considered such costs, the issue whether it has disclosed enough raw information is beside the point.

In sum, when viewed as an administrative decision-making device, the zero-release assumption of Table S-3 constitutes a violation of NEPA. Under section 706(2)(A) of the APA, it is, therefore, "not in accordance with law."[134]

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[131] As stated above, it may be that certain costs can be assessed and *balanced* against certain benefits at the generic level. *See* p. 44 *supra*. That, however, is not what the NRC has done here.

[132] *See* p. 43 *supra*.

[133] *See* p. 31 *supra*. This is not a simple matter of how and where the environmental impact of an action is disclosed as Amicus Commonwealth Edison *et al.* contend. *See* Commonwealth Edison *et al.* Brief at 12 n.4; Scientists' Institute for Public Information, Inc. v. AEC, 481 F.2d 1079, 1092-93 (D.C.Cir. 1973).

[134] We emphatically do *not* hold that the Commission may not proceed in the face of uncertainty, as Judge Wilkey main-

Alternatively, the same result can be reached under the arbitrary and capricious standard.[135] Under that standard, as stated above, our inquiry focuses upon whether the zero-release assumption is based on "consideration of the relevant factors."[136] Under NEPA, significant uncertainty surrounding the environmental effect of a proposed action is relevant to an agency's decision to rule generically that the effect will not occur. For an agency to go forward in the face of significant uncertainty and issue such a rule indicates either a failure to consider a relevant factor or a clear error in judgment. Because that is precisely what the Commission did in promulgating the Table S-3 Rule, we could also conclude that its action was arbitrary and capricious.[137]

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tains, *see, e.g.*, Wilkey op. at 55, or that the uncertainty surrounding the zero-release assumption may be factored into the cost-benefit calculus only at the individual licensing level. Judge Wilkey has seriously misconstrued this issue. We do, however, hold that *where* the Commission has not factored the uncertainties surrounding its assumptions into a generic rule like the Table S-3 Rule, it cannot *also* preclude individual licensing boards from considering those uncertainties when applying the values provided by the Rule.

[135] At one point in its opinion remanding this case, the Supreme Court implied that this court could review the Table S-3 Rule only under the arbitrary and capricious standard. Vermont Yankee Nuclear Power Corp. v. NRDC, 435 U.S. 519, 535-36 n.14. Although we do not believe that this was the Supreme Court's intention—particularly in view of the fact that the later versions of the Rule reveal that the zero-release assumption may not have been simply a factual finding—we reach the same result under the "not in accordance with law" standard and the "arbitrary and capricious" standard.

[136] Bowman Transportation, Inc. v. Arkansas-Best Freight System, Inc., 419 U.S. 281, 285 (1974); Citizens to Preserve Overton Park, Inc. v. Volpe, 401 U.S. 402, 416 (1971). *See* pp. 28-29 *supra*.

[137] Judge Wilkey maintains that an agency may assess an uncertain environmental effect generically and prescribe that individual EISs reflect only a most probable—or modal—

B. *Consideration of Other Uncertainties*

The NRDC seems to argue that Table S-3 masks uncertainties underlying waste-management activities other than permanent disposal.[138] It has not, however, indicated where those uncertainties lie or what values in the Table obscure them. Similarly, the Commission has responded to the NRDC by focusing primarily on the uncertainties surrounding the successful development of a permanent repository.[139] As a result, we face considerable difficulty reviewing this issue.

Table S-3 lists several gaseous and liquid radiological effluents along with low-level, high-level and transuranic solid wastes.[140] The gaseous and liquid effluent releases are expected to occur at the early stages of the waste-management process, before the wastes are solidified and prepared for permanent disposal. The staff reports sup-

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value for the effect. *See, e.g.*, Wilkey op. at 48-51. We strongly disagree. NEPA requires the consideration and disclosure of significant uncertainties concerning environmental effects. A generic rule limiting consideration and disclosure to modal values would fly in the face of that requirement, allowing individual decisions to be made without regard to improbable yet potentially severe environmental damage. Improbable yet potentially severe environmental damage is as much an environmental cost as certain or probable damage, and to allow decisions to be made without consideration of *any* significant—even if probabilistic—environmental effect constitutes a violation of NEPA. Judge Wilkey states that an agency's consideration of uncertainties prior to promulgating a generic rule satisfies NEPA's requirement that uncertainty be considered. *Id.* In this case, however, that consideration was undertaken in the abstract. It did not allow the agency to reflect upon whether potentially severe environmental costs are warranted by the benefits expected to attend the licensing of a particular plant or nuclear plants in general. That consideration, therefore, was not sufficient to comply with NEPA.

[138] *See* NRDC Brief at 31-38.

[139] *See* NRC Brief at 34-39.

[140] *See* note 8 *supra* (copy of Table S-3).

porting the Table S-3 Rules indicate that there is indeed uncertainty concerning the predictions of these releases. In contrast to its method of projecting releases from the solid waste stored in a permanent repository, however, it appears that the Commission used "worst case" estimates in determining Table S-3's values for gaseous and liquid releases. The Commission assumed, for example, that all of the tritium, krypton-85 and carbon-14 in spent fuel would be discharged into the environment during reprocessing.[141] The Commission also seems to have used equally conservative assumptions in determining Table S-3's values for releases of iodine-129, iodine-131 and other radioactive gases.[142] One issue before us, therefore, is whether the Commission violated NEPA in treating these uncertainties in this manner, rather than by representing uncertainty itself in the Table. We hold that it did not.

As we have emphasized above, NEPA requires an agency to consider the environmental risks of a proposed action in a manner that allows the existence of such risks to influence the agency's decision to take the action.[143] An agency can do this by having the appropriate decisionmakers consider all that is known and unknown about the risks before deciding whether to take an action. Or, it can organize its decisionmaking process in such a manner that the appropriate decisionmakers consider only the upper bound of reasonably foreseeable environmental costs. If, after considering that level of environmental damage, the decisionmakers conclude that the proposed action is worth its societal costs, full account will have been taken of the action's environmental impact. Similarly, if the upper bounds of environmental risks are disclosed in an EIS, Congress, the public, and any interested

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[141] *See* Conclusions and Recommendations of the Hearing Board (October 26, 1978), IV JAS at 1439-40.

[142] *Id.* at 1443-46.

[143] *See* p. 31-32 *supra*.

agency can effectively assess for themselves whether the agency has proposed an action that is not worth its environmental costs. Either method of considering and disclosing uncertainties surrounding an environmental effect is acceptable under NEPA.[144] Thus, to the extent that the Commission has listed the upper bound of reasonably foreseeable gaseous and liquid effluent releases in Table S-3, we hold that it has complied with NEPA.

It is impossible for this court to determine whether there are other numerical values in Table S-3 that mask uncertainties without using such conservative heuristic devices as a worst-case scenario. We expect, however, that the Commission's consideration of uncertainties underlying the zero-release assumption will encompass any significant uncertainties underlying other values in the Table.[145]

C. *Consideration of Health, Socioeconomic and Cumulative Effects*

Petitioner NRDC also challenges the original and interim Rules for failing to allow proper consideration or disclosure of the actual environmental impact of the fuel-cycle.[146] In all versions of the Rule, Table S-3 lists the environmental effects of the fuel cycle in terms of the quantity of land, water, and energy used, and of heat, chemicals and radioactivity released. It does not reveal the meaning of those impacts in terms of human health or other environmental values. The Table does not, for instance, indicate the number of cancer deaths or genetic

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[144] *See* North Slope Borough v. Andrus, 642 F.2d 589, 605 (D.C. Cir. 1980).

[145] These include uncertainties surrounding the health, socioeconomic, and cumulative impacts of the back end of the uranium fuel-cycle and the economics of the projected waste-management and disposal facilities. *See* pp. 52-68 *infra*.

[146] NRDC Brief at 18-31.

defects to be expected. Nor does it refer to potential social, psychological, and economic disruptions that might accompany the siting of waste repositories, the construction of reprocessing and disposal facilities, or the maintenance of safety and security over long periods of time. Furthermore, the Table, which is based on the incremental impact of one prototypical reactor operating for one year, assumes that there will be no cumulative effects of licensing scores of reactors each of which will remain in operation for thirty to forty years.

There can be no dispute that NEPA requires the health, socioeconomic and cumulative impacts of a proposed action to be disclosed in an EIS.[147] Otherwise, the statement could not fulfill its purpose of informing the public, Congress, and other decisionmakers of the environmental impact of the action.[148] Nor could the environmental cost-effectiveness of a proposed action be compared to that of alternative actions if the environmental

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[147] *See, e.g.*, Kleppe v. Sierra Club, 427 U.S. 390, 410 (1976) (cumulative effects); NRDC v. Callaway, 524 F.2d 79, 88 (2d Cir. 1975) (cumulative effects); Named Individual Members of San Antonio Conservation Society v. Texas Highway Dept., 446 F.2d 1013 (5th Cir. 1971), *cert. denied*, 406 U.S. 933 (1972) (cumulative effects); Trinity Episcopal School Corp. v. Romney, 523 F.2d 88, 93 (2d Cir. 1975) (socioeconomic effects); Prince George's County v. Holloway, 404 F.Supp. 1181, 1186 (D.D.C. 1975) (socioeconomic effects); 40 C.F.R. §§ 1508.7, 1508.8 (1981) (health, social, economic, cumulative).

[148] *See, e.g.*, Silva v. Lynn, 482 F.2d 1282, 1285 (1st Cir. 1973): "[The EIS] must be written in language that is understandable to nontechnical minds and yet contain enough scientific reasoning to alert specialists to particular problems within the field of their expertise." (quoting Environmental Defense Fund, Inc. v. Corp. of Engineers, 348 F.Supp. 916, 933 (W.D. Miss. 1972)). *Cf.* Vermont Yankee Nuclear Power Corp. v. NRDC, 435 U.S. 519, 557 (1978) (the reports used to prepare the EIS may be technical in nature); 40 C.F.R. § 1502.8 (1981) (EIS should be written so that "decisionmakers and the public can readily understand them").

effects of each are not disclosed in such commensurable terms. In this case, therefore, it is not releases of curies that Congress wanted disclosed; it is the effects, or environmental significance, of those releases. Those effects are defined by the CEQ regulations to include:

> ecological (such as the effects on natural resources and on the components, structures, and functioning of affected ecosystems), aesthetic, historic, cultural, economic, social, or health, whether direct, indirect, or cumulative.[149]

Hence, the issue before us is whether the provisions of the original and interim Rules that governed the use of Table S-3 allowed for proper consideration of these environmental values.

Our resolution of that issue is complicated by the fact that the relevant provisions of the Rule have undergone several transformations since their initial promulgation. The original and interim Rules provided that "the contribution of the environmental effects of . . . fuel cycle activities shall be as set forth in the following Table S-3 . . . [and] no further discussion of such environ-

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[149] 40 C.F.R. § 1508.8 (1981). Environmental impacts must be considered and disclosed in these terms in order to facilitate the comparison of alternative actions that entail different types of environmental damage—for example, radiological and chemical releases. Furthermore, an EIS must translate technical effluent data into such terms if it is effectively to disclose the environmental impacts of a proposed project to its intended readership: interested members of the public, public servants, and legislators. That audience cannot be expected to convert curies or mrems into such costs as cancer deaths, or social disturbance. Moreover, the expression of environmental costs in terms of actual health and socioeconomic effects is necessary to convey to that audience the basis of an agency's decision. The impacts of nuclear reactors on human health and society are matters of legitimate scientific debate, and NEPA gives the public the right to know the tangible environmental costs that the Commission expects it to pay in return for the anticipated benefits of such a plant.

mental effects shall be required." [150] Prior to 1977, individual licensing boards interpreted this clause to preclude their consideration of the environmental significance of the numerical values listed.[151] In its January 1977 *Hartsville* decision, however, the Commission's Appeal Board ruled that a licensing board must consider the relative health effects of a proposed nuclear power plant and a coal-fired alternative.[152] Then, in April 1978, the Commission promulgated a "clarifying" amendment to the interim Table S-3 Rule which specifically provided that health effects could be considered by individual licensing boards.[153] In addition, the Commission broadened the scope of licensing boards' consideration by amending the restriction on such consideration to read: "No further discussion of the environmental effects *addressed by the Table* shall be required." [154] The amended interim Rule did not, however, explicitly address the consideration of any type of impact other than health effects. Ultimately—or perhaps penultimately—in the final Rule, which the NRDC does not challenge, the Commission resolved the issue by requiring licensing boards to consider the socioeconomic and cumulative effects in addition to the health effects of the releases projected in the Table.[155] At that point, the Commission also indicated

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[150] 39 Fed. Reg. 14188, 14191 (1974); 42 Fed. Reg. 13803, 13806 (1977). The staff report supporting the original Rule did not address the health, socioeconomic or cumulative effects of the fuel cycle at all; and the report supporting the interim Rule contained only cursory references to those effects. *See, e.g.*, NUREG-0116, *supra* note 14, at 2-19 to 2-20, 4-168 to 4-171.

[151] *See* p. 57 *infra*.

[152] In re Tennessee Valley Authority (Hartsville Nuclear Plant), ALAB-367, 5 N.R.C. 92 (1977).

[153] 43 Fed. Reg. 15613, 15617 (1978) (change in footnote 1); *see id.* at 15616.

[154] *Id.* at 15617 (emphasis added).

[155] 44 Fed. Reg. 45362, 45371 (1979).

that it would conduct further proceedings to determine such health, socioeconomic and cumulative effects on a generic basis, and thereby eliminate the need for case-by-case consideration.[156]

The NRDC argues that the original, the interim and the amended interim Rules violated NEPA by preventing licensing boards from considering the health, socioeconomic and cumulative effects of fuel-cycle activities.[157] The Commission responds by arguing that each version of the Rule complied with NEPA because none explicitly precluded such consideration. We find the Commission's argument unpersuasive.

The original Rule and the interim Rule, prior to its amendment, stated that "the contribution of the environmental effects of . . . fuel cycle activities shall be as set forth in the following Table S-3 . . . [and] no further discussion of *such* environmental effects shall be required."[158] The term "such" refers to the phrase "the contribution of the environmental effects of . . . fuel cycle activities." Therefore, the Rules unambiguously stated that a licensing board's consideration and an EIS's disclosure of the environmental effects of fuel-cycle activities could be limited to the information contained within the four corners of Table S-3. Moreover, it appears that the impact of the Rules was to preclude further consideration or disclosure. The background of the Rules makes this conclusion even clearer. Recall that the proposal for the original Rule suggested two ways of dealing with the environmental effects of fuel-cycle activities.[159] One approach was to ignore those environmental effects in in-

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[156] *Id.*; *see* 46 Fed. Reg. 15154 (1981) (proposed narrative Rule); note 168 *infra*.

[157] NRDC Brief at 18-31.

[158] 39 Fed. Reg. 14188, 14191 (1974); 42 Fed. Reg. 13803, 13806 (1977) (emphasis added).

[159] *See* p. 15 *supra*.

dividual licensing proceedings as the Appeal Board had allowed in *Vermont Yankee;* and the other, which was adopted, was to factor those effects into individual cost-benefit analyses by using Table S-3. Since the Table S-3 Rule was adopted as an alternative to a rule that would have permitted no consideration or disclosure of the environmental effects of the fuel cycle, it was reasonable for licensing boards and interested parties to conclude that the Rule limited consideration of such environmental effects to the introduction of the Table.[160] The Commission itself has recognized as much. For instance, in promulgating the final Rule, the Commission stated that the Table S-3 Rule "at least initially was apparently interpreted as cutting off further discussion of fuel cycle impacts" [161] and that

> the rule in practice [was applied] as allowing fuel cycle impacts to be addressed in reactor licensing proceedings solely by the formal act of displaying Table S-3 in impact statements, with no further discussion. In particular, impact statements prepared by the staff did not analyze fuel cycle impacts in terms of health effects which might be caused by the radioactive releases tabulated in the rule and did not discuss socioeconomic or cumulative impacts.[162]

The original Rule and the interim Rule, prior to its amendment, thus effectively eliminated the consideration and disclosure of the health, socioeconomic and cumulative impacts of fuel-cycle activities. The NRC, there-

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[160] In proposing the original Rule, the Commission commented that "such matters, if they are to be considered at all, be considered in a generic fashion through a rulemaking process." 37 Fed. Reg. 24191, 24192 (1972).

[161] 44 Fed. Reg. 45362, 45364 (1979).

[162] *Id.*

fore, in promulgating the original and interim Rules violated NEPA.[163]

The Commission argues that the Appeal Board's *Hartsville*[164] decision eliminated any preclusive effect that the Rules may have had on the consideration of health, socioeconomic and cumulative impacts.[165] We disagree. First, the decision in *Hartsville* was itself ambiguous. Although holding, in general, that a licensing board had to examine the comparative health effects of a nuclear plant and the alternative of a coal-fired plant, the Appeal Board specifically refrained from considering any environmental effect of waste-management and disposal activities, awaiting direction from the Commission in the then-pending interim Table S-3 Rule.[166] Second, the *Hartsville* decision only addressed health effects in the context of comparing a nuclear plant with a coal-fired alternative.[167] Finally, the *Hartsville* decision did not address cumulative or socioeconomic effects. Thus, even after *Hartsville*, it remained apparent that the consideration of health, and particularly, cumulative

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[163] As is true of the Commission's treatment of the zero-release assumption, this violation of NEPA could also be characterized as being arbitrary and capricious. *See* p. 49 & note 135 *supra*. Under NEPA, the health, socioeconomic and cumulative effects of a proposed action must be considered and disclosed. The presence of such effects is relevant to an agency's decision to promulgate a generic rule prescribing the scope of its consideration and disclosure of the environmental effects of proposed actions prior to taking such actions. In promulgating the original and interim Table S-3 Rules, however, the Commission ignored the presence of those types of environmental effects. Its action, therefore, was arbitrary and capricious. *See* p. 29 *supra*.

[164] In re Tennessee Valley Authority (Hartsville Nuclear Plant), ALAB-367, 5 N.R.C. 92 (1977).

[165] NRC Brief at 41-42.

[166] In re Tennessee Valley Authority (Hartsville Nuclear Plant), ALAB-367, 5 N.R.C. 92 (1977).

[167] *Id.* at 103 n.52.

and socioeconomic impacts of the fuel cycle was precluded by the Table S-3 Rules.[168]

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[168] We also cannot accept the argument that the Commission made a factual finding that these fuel cycle effects were insignificant. The Commission has acknowledged:

> A record is not yet available to support a comprehensive rule dealing with all generic aspects of fuel cycle impacts relevant to reactor licensing . . . . The table of impacts adopted as a final rule . . . serves as an important first step [by] relieving adjudicatory boards from the need to determine those numerical impacts of the uranium fuel cycle which have been extensively considered in generic rulemaking. Ultimately, however, the impacts of the releases and not the releases themselves dictate the standards the Commission must set.

44 Fed. Reg. 45362, 45363 (1979). The Commission then initiated the process to consider the significance of the health, socioeconomic, and cumulative effects of the uranium fuel cycle in a generic rulemaking proceeding. *Id.* at 45371; *see* 46 Fed. Reg. 15154 (1981). The proposed outcome of that proceeding is to find most of these effects to be insignificant. *Id.* at 15154. That result is, at this stage only proposed. Even if adopted, it is not before us and we express no opinion on whether the Commission may make such a determination by rule, whether an EIS is required for such a determination, or whether such a determination can be adequately supported. Before deciding not to delay the issuance of our opinions pending completion of the narrative rulemaking, *see* Edwards op. at n.2, we ordered the NRC to advise us as to the status of that proceeding. In response, the Commission stated that

> The Commission has received public comments regarding the proposed rule, and the NRC staff is continuing to analyze those comments and prepare proposed responses for the Commission's approval. As yet, however, a proposed final rule has not been submitted to the Commission and no date has been set for such submission. Therefore it appears that the Commission's present fuel cycle rule (Table S-3) is not likely to be supplanted in the immediate future.

Letter from NRC, dated October 16, 1981.

Not until the Commission's amendment of the interim Rule did it become reasonably clear that health, cumulative, or socioeconomic impacts could be considered in individual licensing proceedings under the Table S-3 Rule.[169] Even with the amendment, in fact, there could be some doubt as to whether or not cumulative or socioeconomic impacts were still precluded from consideration. As stated above, the amended Rule and its Statement of Consideration referred explicitly to health effects, but not to socioeconomic or cumulative effects.[170] Nevertheless, it did replace the language that had effectively limited licensing boards' consideration and disclosure of the environmental effects of fuel-cycle activities to the values listed in Table S-3. The new language precluded consideration of the effects "addressed by the Table."[171] Because socioeconomic and cumulative effects were not addressed by the Table, the terms of the amended Rule did not prevent licensing boards from considering such effects and should not have prevented such effects from being disclosed in environmental impact statements. Thus, the amendment of the interim Rule eliminated the NEPA violation.

In view of the foregoing, we hold that the original Table S-3 Rule and the interim Table S-3 Rule, prior to amendment, were invalid. Although the amended interim Rule, and later the final Rule, allowed consideration of health, socioeconomic, and cumulative effects, a number of licenses issued under the original and unamended interim Rules have been challenged. Several of those cases are currently pending in this circuit awaiting this decision.[172]

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[169] *See* 43 Fed. Reg. 15613 (1978).

[170] *See* p. 55 *supra*.

[171] *See id.*

[172] *See* note 7 *supra*.

D. *Economic Feasibility*

Petitioner, the State of New York, and Intervenor, the State of Wisconsin, argue that the effluent-release values listed in Table S-3 assume the use of technology that is economically infeasible, even if it is technologically feasible. They argue, first, that the Commission applied an improper standard of economic feasibility in concluding that its projected releases are reasonably foreseeable; second, that the Commission's cost estimates are incorrect, and third, that the Commission failed to explain the basis of its finding of feasibility.[173] We conclude that, although the Commission could have been clearer in setting out its reasons for determining that Table S-3's predictions are economically feasible, the determination itself was not arbitrary or capricious.[174] Therefore, we affirm the Commission on this issue.

As Judge Tamm stated in our initial decision in this case, "[t]he Commission should be able to supply the court with a statement of the methods by which its staff

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[173] New York argued before the Hearing Board that the Commission must address the economic feasibility of its projections. The Commission staff argued, in response, that the issue need not be addressed. II JAS at 439-40. The Hearing Board, however, held that the issue should be addressed and took evidence from New York, Wisconsin, and Ohio purporting to show that the values projected in Table S-3 were not economically feasible. *See* Commission's Order, Feb. 9, 1978, IV JAS at 1254 (Commission affirming Hearing Board).

[174] Judge Wilkey's dissent questions why we treat this issue differently than the uncertainty issue. The answer is simple: the issues are significantly different. The NRDC challenges not the conclusion that the zero-release assumption is reasonable, but rather the arbitrary exclusion of the uncertainties surrounding that assumption from any consideration in the licensing process. Here, New York challenges the Commission's *conclusion* that the facilities will be economically feasible. Economic uncertainties, of course, still must be factored into the analysis. *See* note 145 *supra*.

arrived at the figures embodied in Table S-3 and by which [its staff] concluded that the waste storage problem is already technologically and economically soluble." [175] The values in Table S-3 are based on assumptions concerning the types of technology that will be used in waste-management and disposal activities.[176] For those values to represent reasonably foreseeable environmental effects, as required by NEPA, the use of that technology must be reasonably foreseeable. It must, therefore, be both technologically and economically feasible.[177]

In concluding that the facilities required to meet the effluent projections of Table S-3 are economically feasible, the Commission applied a standard of whether the facilities are "prohibitively" or "outrageously expensive." [178] Although the Commission's articulation of the standard is somewhat nebulous, we interpret it to mean that a facility would be economically feasible if its ex-

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[175] NRDC v. NRC, 547 F.2d 633, 661 (D.C.Cir. 1976) (Tamm, J., concurring). *rev'd sub nom.* Vermont Yankee Nuclear Power Corp. v. NRDC, 435 U.S. 519 (1978) (NEPA requires Commission to find technological and economic feasibility). *See also* 547 F.2d at 658 (same).

[176] *See, e.g.*, pp. 39-40 *supra*.

[177] In the abstract, economic and technological feasibility may be closely related. A piece of technology that is so expensive that no private or public institution could ever amass the resources necessary to develop it may be characterized as technologically infeasible when in fact it is feasible as a purely technological matter. That type of economic feasibility is addressed, though indirectly, in Sections A and B, above. The concept of economic feasibility that New York and Wisconsin are questioning seems to be one that is well within the bounds of affordability in this extreme sense. The concept of economic feasibility that underlies New York's and Wisconsin's argument seems to be one of affordability by particular economic institutions that can reasonably be expected to have responsibility for bearing the cost of a piece of technology.

[178] 44 Fed. Reg. 45362, 45367 (1979).

pected cost is no more than the nuclear power industry will pay, under the regulation of the NRC or with the aid of reasonably foreseeable public subsidization.[179]

New York and Wisconsin argue that "[e]conomic feasibility must be determined in the context of private enterprise, and the question is whether the costs are feasible for the profit-making sector."[180] The basis of their argument seems to be that if it is very expensive to limit effluent discharges to the levels predicted in the Table, the nuclear power industry may economize, at the expense of the public, by allowing higher discharges.[181] We find this approach untenable. The standard of economic feasibility may be based on realistic, conservative, and reasoned forecasts of who will have to pay the costs of waste management and disposal, and under what type of compulsion.[182] The history of the federal government's commitment to regulate and subsidize the nuclear power industry, and to operate certain nuclear facilities itself, is clear and long-standing. Moreover, at least the final repository envisioned by the Commission is expected to be developed and operated by the federal government.[183] The Commission, in making its prediction of economic feasibility, therefore, was justified in making the reasonable assumption that the regulatory structure

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[179] In its Statement of Consideration the NRC stated:

> Whether nuclear power is good business is not an issue in this rulemaking. The fuel cycle rule will be used only when somebody has decided, rightly or wrongly, that nuclear power is sufficiently viable economically to warrant applying for a reactor license. Once the reactor has operated, back-end fuel cycle activities must be carried out, whatever the cost.

Id.

[180] New York/Wisconsin Reply Brief at 6.

[181] New York/Wisconsin Brief at 28.

[182] Scientists' Institute for Public Information, Inc. v. AEC, 481 F.2d 1079, 1092 (D.C.Cir. 1973).

[183] NUREG-0116, *supra* note 14, at 4-29, 4-71.

of the nuclear power industry would remain basically unchanged.[184] Under that structure, the NRC will have the power to regulate the industry in such a manner that no private firm will be able to, let alone have an incentive to, cut its costs by allowing the release of more effluents than those projected in Table S-3. If it turns out that the industry cannot pay the full cost of managing and disposing of the waste it has created, it is reasonable to expect the federal government to help out, for society as a whole can be expected to prevent private industry from taking chances in handling nuclear waste. Because the possibility that a firm will have in a socially irresponsible manner is well within the control of the Commission, we hold that the Commission correctly determined that the standard of economic feasibility is that level of costs that the industry in combination with the federal government can reasonably be expected to pay. Of course, we can only hope that the Commission, in fact, exercises its control over the industry in a manner consistent with the public interest.[185]

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[184] *See* Sierra Club v. Morton, 510 F.2d 813, 827-28 (5th Cir. 1975) (NEPA analysis does not have to ignore continuing regulatory and monitoring responsibilities); NRDC v. Morton, 458 F.2d 827, 837 (D.C. Cir. 1972) (elimination of fundamental legislative schemes, such as antitrust laws, need not be considered).

[185] In its brief, the NRC states that:

> the "operators" of fuel cycle facilities, whether government or private, will be subject to NRC regulation and will not have the option of cutting costs by allowing further releases if these would exceed the Commission's regulatory standards. The Commission's finding of economic feasibility thus in a sense expresses *agency policy not to lower standards*, even if this were legally permissible, on account of the predicted level of costs.

NRC Brief at 27 (emphasis added). A future change in such an agency policy may well be an agency action that significantly affects the environment.

As Judge Edwards correctly points out, an agency may not simply assume that the federal government will subsidize the

New York and Wisconsin challenge, as arbitrary and capricious, both the cost estimates that the Commission accepted,[186] and the conclusion that such costs would be feasible.[187] The major elements of the Commission's cost estimates that New York and Wisconsin challenge are the discount rate used and the estimate of decommissioning costs.

In preparing the cost estimates in question, the Commission staff discounted future expenditures to present values at a ten percent rate. In the rulemaking proceeding and again before this court, New York objected to both the discounting procedure and the discount rate used, arguing that a discount rate from zero to two percent would be more appropriate.[188] We find, however, that although this argument may be meritorious, it does not undermine the Commission's finding of feasibility, because both the Hearing Board and the Commission used discount rates of zero and two percent in estimating the range of expected costs.[189]

New York and Wisconsin also argued before the Commission, and now before this court, that the Commission underestimated, by a factor of ten, the cost of decon-

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prevention of foreseeable environmental damage. Nevertheless, in an area such as this, where there is a long history of federal involvement—including subsidization—we cannot say that an agency errs if it projects that a relatively minimal level of federal funding would become available if it turns out that private industry alone cannot prevent serious environmental damage.

[186] New York/Wisconsin Brief at 35-50.

[187] *See* 44 Fed. Reg. 45362, 45367 (1979); Hearing Board Conclusions and Recommendations, at 58, IV JAS at 1480.

[188] Report of Hearing Board, August 31, 1978, at 126-130, III JAS at 1056-1060.

[189] 44 Fed. Reg. 45362, 45367 & n.18 (1979); Hearing Board Conclusions and Recommendations, at 52-53, 57-58; IV JAS at 1475-1476, 1479-80.

taminating and decommissioning (D&D) a reactor.[190] Although the Hearing Board took evidence on D&D costs, the Commission ultimately decided that the consideration of such costs should be relegated to individual licensing proceedings.[191] D&D costs were consequently held to be irrelevant to the economic feasibility of the Table S-3 values. The effluent values in Table S-3 nevertheless continue to include effluents emitted from decommissioned plants.[192] We must assume, therefore, that licensing boards will use Table S-3's values attributable to decommissioning only if they are assured that the decommissioning method assumed by the Table is reasonably likely to be the method used for the individual reactor under consideration. If not, we assume that the licensing board will be free to consider the full environmental costs of whatever decontamination and decommissioning method is expected to be used.[193] Thus to this limited extent, we interpret the Table S-3 Rule to be nonpreemptive. Therefore, we reject New York's and Wisconsin's contention that Table S-3 is invalid because of inaccuracies in the D&D cost estimates.

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[190] Hearing Board Conclusions and Recommendations, at 54-56, IV JAS 1476-78; New York/Wisconsin Brief at 35-50.

[191] 44 Fed. Reg. 45362, 45367 n.18 (1979); *see* Hearing Board Conclusions and Recommendations, at 56, IV JAS at 1478.

[192] *See* note 8 *supra*.

[193] The Hearing Board stated that "[t]he cost [of decommissioning a reactor] is specific to each plant and *depends on the method chosen*. Controversies regarding the decommissioning costs should be resolved in individual reactor licensing proceedings." Hearing Board Conclusions and Recommendations, at 56, IV JAS at 1478 (emphasis added). Similarly the Commission found the "costs of decommissioning a power reactor . . . [to be] facility-specific and should be considered in individual reactor proceedings *rather than included among the costs of the fuel cycle activities which are the subject of the generic rule.*" 44 Fed. Reg. 45362, 45367 n.18 (1979) (emphasis added).

Using a variety of discount rates and including the staff's estimated decommissioning costs,[194] the Commission found that the projected waste-management and disposal facilities would entail capital costs of between $71 million and $76 million,[195] and operating costs ranging from 0.4 mills/KWh to 1.4 mills/KWh for the once-through cycle and 1.9 mills/KWh to 3.9 mills/KWh for the uranium-only recycle option.[196] The Commission observed that such costs represented less than 10% of the capital costs and less than 5% of the operating costs of a typical reactor.[197] The Commission found these costs to be feasible simply because they represent only a small fraction of the total cost of building and operating a reactor.[198] New York and Wisconsin argue that the finding is arbitrary and capricious because the Commission did not explain *why*, even under the Commission's own standard, these costs are feasible. We conclude that,

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[194] Hearing Board Conclusions and Recommendations, at 52, 54, IV JAS 1474, 1476.

[195] These figures are for the once-through and uranium-only reprocessing cycles, respectively. Hearing Board Conclusions and Recommendations, at 51, IV JAS at 1473.

[196] These ranges are from zero percent discount rate to ten percent discount rate. *Id.* at 52, 54, 57, IV JAS at 1474, 1476, 1479.

[197] These percentages are based on cost estimates, excluding waste management and disposal, of one billion dollars in capital costs and operating expenses of 30 mills/KWh for the model or "typical" reactor. The 5% figure is based on the operating cost of the once-through cycle (1.4 mills/KWh ÷30 mills/KWh). It therefore represents an upper bound, because it is assumed that no reprocessing would take place unless the value of uranium that would be recovered makes up for the higher operating cost of the uranium-only reprocessing cycle. Such an assumption is clearly reasonable. Hearing Board Conclusions and Recommendations, at 51 & n.27, 52, 58-59, IV JAS at 1473 & n.27, 1474, 1480-81.

[198] *Id.* at 58, IV JAS at 1480; *see* 44 Fed. Reg. 45362, 45367 (1979).

although the Commission's reasoning is far from transparent, its finding of economic feasibility is neither arbitrary nor capricious. We recognize that an agency must provide a rational connection between facts found and conclusions reached, and a court may not supply a reasoned basis for an agency's action.[199] Nonetheless, a court must uphold a decision of less than ideal clarity if the agency's path may reasonably be discerned;[200] and in reviewing an agency's decision, a court can only ensure that the agency properly considered all relevant factors, and that its conclusion does not represent a clear error in judgment.[201] In this case, it is apparent that by comparing the projected costs of waste management and disposal to current reactor costs, the Commission was implicitly considering the level of private and, if necessary, public resources that could reasonably be expected to be available for these activities.[202] Because these waste-management and disposal expenses represent a comparatively small addition to the resources needed to build and operate a reactor, and because a plant need not be built if it appears that those expenses will render the plant unprofitable, we cannot say that the Commission clearly erred in determining that sufficient resources would be available. The Commission has thus addressed the relevant factor of the availability of private and public

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[199] SEC v. Chenery Corp., 332 U.S. 194, 196 (1947).

[200] Colorado Interstate Gas Co. v. Fed. Power Comm'n, 324 U.S. 581, 595 (1945).

[201] Bowman Transportation, Inc. v. Arkansas-Best Freight System, 419 U.S. 281, 285 (1974); Citizens to Preserve Overton Park, Inc. v. Volpe, 401 U.S. 402, 416 (1971).

[202] *See* Hearing Board Conclusions and Recommendations, at 58 & n.41, IV JAS 1480 & n.41; Transcript at 1291, II JAS 744 (comment of Hearing Board member Briggs).

See also note 185 *supra*. Our doubts about the Commission judgment that such resources will be available would be greater if these costs did not represent such a relatively small increment to the present costs of nuclear power.

resources and reached a conclusion that is within the range of reasonability. We conclude that the Commission's finding of economic feasibility was not arbitrary or capricious, and dismiss the petition in No. 79-2110.

CONCLUSION

For the foregoing reasons, we hold that the original, interim and final Table S-3 Rules are invalid due to their failure to allow for proper consideration of the uncertainties that underlie the assumption that solidified high-level and transuranic wastes will not affect the environment once they are sealed in a permanent repository. We also hold that the original Rule and the interim Rule, prior to its amendment, are invalid due to their failure to allow for proper consideration of the health, socioeconomic and cumulative effects of fuel-cycle activities. We conclude, however, that the Commission's finding of economic feasibility was not arbitrary or capricious. We, therefore, vacate all three Rules. Licenses already granted under the Rules are not at issue in this action, and we accordingly express no view as to their validity. The validity of those licenses will be determined in subsequent proceedings.[208]

Vacated and Remanded

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[208] *See* note 7 *supra*.

EDWARDS,* *Circuit Judge*, concurring in part and dissenting in part.

This case may prove to be one of the most important cases to be decided by the United States courts in this century. The United States Supreme Court, in reversing this court's previous remand of this case to respondent, the Nuclear Regulatory Commission (NRC or Commission), emphasized the magnitude of the problem it was sending back for our reconsideration:

> The Commission itself, in a pamphlet published by its information office, clearly recognizes that these wastes "pose the most severe potential health hazard . . . ." U.S. Atomic Energy Commission, Radioactive Wastes 12 (1965). Many of these substances must be isolated for anywhere from 600 to hundreds of thousands of years. It is hard to argue that these wastes do not constitute "adverse environmental effects which cannot be avoided should the proposal be implemented," or that by operating nuclear power plants we are not making "irreversible and irretrievable commitments of resources." 42 U.S.C. §§ 4332(2)(C)(ii), (v).

Vermont Yankee Nuclear Power Corp. v. Natural Resources Defense Council, 435 U.S. 519, 538-39 (1978), *rev'g Natural Resources Defense Council v. Nuclear Regulatory Commission*, 547 F.2d 633 (D.C. Cir. 1976).

In this case we are required to review the continuing effort of the NRC to pit human intelligence against the most primordial force of nature. This force, when involved in its most awful manifestation, exceeds the power of flood, fire, pestilence, earthquake, hurricane and volcano. In this century, it has been demonstrated in this and other countries that this force can be employed for peace and war—for warming a baby's bottle and for nuclear holocaust.

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* Honorable George Edwards, Chief Judge, U.S. Court of Appeals for the Sixth Circuit, sitting by designation.

It is not the function of the judicial branch either to initiate or to halt the development of a nuclear power industry. These national policy choices are constitutionally vested in the President and the Congress of the United States, and they have been made in favor of proceeding.

This court's limited function is to determine from the agency record before us whether or not the Commission's decision to adopt certain Tables S-3, 10 C.F.R. § 51.20(e) (1981), was "arbitrary, capricious, an abuse of discretion, or otherwise not in accordance with law."[1] The S-3 Tables instruct the licensing boards, which are delegated the task of licensing all new nuclear power plants, that there will be "zero" release of emissions or releases so small as to be insignificant,[2] from the nuclear waste accumulated or to be accumulated from plants now licensed or which may be licensed during the 2,500 centuries it will take for that waste to decay. *Thus the Commission seeks to preclude further licensing hearings from considering the hazards from unanticipated, accidental or willful release of emissions beyond those specified in the Tables from the highly toxic and potentially explosive wastes generated by nuclear power plants during temporary storage, reprocessing, transportation and 250,000 years of burial.* 46 Fed. Reg. 15154, 15156 (March 4, 1981).

I concur fully with Judge Bazelon's opinion for the court, except for the cost issue.

I write separately in concurrence to express deep concern for additional problems and uncertainties that I be-

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[1] 5 U.S.C. § 706(2)(A) (1976).

[2] I choose the term "insignificant" to describe the impact of the many release figures set forth in the three S-3 Tables because the NRC's staff has equated them with the impact on human health of "a few puffs on a cigarette [or] a few sips of wine." 46 Fed. Reg. 15154, 15167 (March 4, 1981).

lieve to be buried in the naked figures and enigmatic footnotes of the Tables S-3 that this appeal requires us to review. Further, in computing the cost of the proposed nuclear waste disposal system, the NRC has not included the costs of surveillance of and guarding the public from the toxic effects from nuclear waste at all disposal sites for somewhere between 10,000 to 250,000 years. As a consequence, I dissent from the opinion for the court on this issue and state my reasons at the end of this opinion.

My concurrence with Judge Bazelon is based on the reasoning he has ably set forth. But I find what appear to me to be even more substantial reasons to agree with his result. An integral part of the "back end" of the nuclear fuel cycle involves the NRC's plan for reprocessing spent fuel rods. Reprocessing involves extraction from the spent fuel rods of either the remaining uranium and plutonium (uranium and plutonium recycle) or just the remaining uranium (uranium-only recycle). Both elements can be prepared as fuel usable in light-water reactor power plants. The uranium can be enriched and again fashioned into uranium-based fuel rods; in the alternative, the plutonium can be combined with uranium to form mixed oxide fuel rods. There are many indications in this record that the Commission originally intended to use both uranium and plutonium extracted by reprocessing as supplementary fuel in all nuclear power plants, licensed or to be licensed.

On April 7, 1977, a presidential order indefinitely suspended reprocessing of spent fuel. 13 WEEKLY COMP. OF PRES. DOC. 506. A new presidential statement on nuclear energy policy, however, dated October 8, 1981, "lift[ed] the indefinite ban which previous administrations placed on commercial reprocessing activities in the United States." 17 WEEKLY COMP. OF PRES. DOC. 1102. There is now reason to believe that the Commission will

proceed with plans to reprocess spent fuel rods thus extracting both uranium and plutonium.

Table S-3 in its final form purports to summarize all "releases" that may be expected in the entire nuclear fuel cycle, except for radon and technetium, which are irrelevant to our present considerations. Moreover, in a proposed "Narrative Explanation of Table S-3," the NRC states that "the environmental impacts from reprocessing and related waste management activities are nearly identical for the recycling of uranium and plutonium, and for the recycling of uranium only, as fuel in nuclear power reactors." 46 Fed. Reg. 15154, 15161 (March 4, 1981).

The proposed narrative avoids discussing the potential environmental impacts of plutonium. The Commission has not, however, disavowed its option to use both uranium and plutonium as reactor fuel—probably in the form of mixed oxide fuel. The NRC may well read any final approval of the S-3 Tables by the federal courts as foreclosing any further public hearings or litigation over the matter.

Absent any clear indication to the contrary from the Commission, I feel prudence requires this court to assume that approval of Tables S-3 would be read by the Commission as judicial sanction for its originally intended—and now presidentially permitted—employment of plutonium as reactor fuel.

Plutonium is the most dangerous substance yet known in the history of the world. Airborne, the tiniest speck of it breathed into a human being will produce lung cancer. Twenty pounds of this powder can be made into a nuclear bomb with the explosive force of the atomic bombs that destroyed Hiroshima and Nagasaki in the fall of 1945. The Commission's originally contemplated nuclear waste disposal scheme included reprocessing of all spent fuel rods from all nuclear power plants now licensed (71) or in contemplation (190). Such reprocessing, depending on the number of plants in operation,

would extract each year 35,000 to 93,500 pounds of plutonium[3] in the form of plutonium oxide. The plutonium, in the form of mixed oxide fuel, would then be transported by truck or rail through many heavily populated areas to all nuclear power plants wherever located in the nation and stored until it is consumed as nuclear fuel.

If this scheme is executed according to what I perceive to be NRC's plan, many private corporations will continually have on hand substantial stocks of the most lethal weapons material ever produced.

Unlike spent fuel rods, plutonium oxide powder can be approached by human beings without fear of radiation. If sealed in an airtight container, it can be transported without harm to the bearer. Also, it is estimated that many thousand people in the United States have the knowledge necessary to fashion a nuclear bomb from this material.[4]

In the dangerous world in which we live, attempts by foreign or domestic terrorists to divert plutonium oxide to international or domestic blackmail or catastrophic destruction must be anticipated.

How NRC contemplates protecting this huge amount of hazardous material from forcible seizure on the highways and rail lines of the United States, and from theft

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[3] Each 1,000 MWe Light Water Reactor produces 200-250 kilograms of plutonium a year. Speth, Tamplin & Cochran, *Plutonium Recycle: The Fateful Step*, BULLETIN OF ATOMIC SCIENTISTS 15, 16 (November 1974). Two hundred-250 kgs. times 2.2 lbs/kg. equals 440-550 lbs. per reactor per year. If we assume a figure of 70 operating reactors, 70 times 440-550 equals 30,800-38,500. If we assume 170 projected reactors, 170 times 440-550 equals 74,800-93,500.

[4] J. McPhee, THE CURVE OF BINDING ENERGY 124 (1974) (figure from interviews with physicist Theodore Taylor). *See* H. Feiveson & T. Taylor, NUCLEAR PROLIFERATION 136-144 (1977); T. Taylor & M. Willrich, NUCLEAR THEFT: RISKS & SAFEGUARDS 12-20 (1974).

or illegal diversion from storage at between 71 and 190 nuclear power plants is most inadequately dealt with in this record.

Finally, the ancient question, "But who is to guard the guards themselves?" is pertinent. The nuclear weapons of the United States are closely guarded by its armed forces. Their employment is subject to command controls so carefully devised that they terminate in the hands of the President of the United States. Yet it appears that the NRC plans to ship bomb-grade materials freely by road or rail, guarded by civilian employees of the private corporation that secures the reprocessing contract. 10 C.F.R. § 70 (1981). And it appears that the NRC may place supplies of plutonium oxide in the form of mixed oxide fuel with its awesome power on the premises of a total of 71 to 190 nuclear power plants under the control of private corporate officers chosen by and responsible to as many private corporate boards of directors. 10 C.F.R. § 72 (1981).

In the long history contemplated for the nuclear power adventure, we cannot be certain that the raw power placed in so many private hands will never be used against the security of our people or of our form of government.

Any failure to deal with the hazards of this plan may be read by the NRC as validation sub silentio of a plan involving incredible dangers. In its original consideration of using atomic energy for production of electric power, Congress repeatedly required "the protection of the health and safety of the public." For the reasons which follow, I would not risk the dangers and uncertainties contained in the S-3 Tables without a prior remand of the NRC reprocessing, transportation and storage plans for thorough briefing and argument as to the legality of said plans for the use of plutonium as fuel under the public health and safety requirements of the Atomic Energy Act of 1954. 42 U.S.C. §§ 2012(d), (e), 2133(b), (d), 2232 (a) (1976).

THE THREE S-3 TABLES

In this case we are now reviewing three variations of Table S-3: an original version, an interim version and a final version. For purposes of this appeal, the differences between the three versions are inconsequential. To illustrate something about the nature of the problem with which this court has been faced, I print the final version of Table S-3 in full:

Table S-3.—*Table of Uranium Fuel Cycle Environmental Data*[1]
[Normalized to model LWR annual fuel requirement [WASH-1248] or reference reactor year [NUREG-0116]]

Environmental considerations	Total	Maximum effect per annual fuel requirement or reference reactor year of model 1,000 MWe LWR
NATURAL RESOURCES USE		
Land (acres):		
Temporarily committed[2]	100	
Undisturbed area	79	
Disturbed area	22	Equivalent to a 110 MWe coal-fired power plant.
Permanently committed	13	
Overburden moved (millions of MT)	2.8	Equivalent to 95 MWe coal-fired power plant.
Water (millions of gallons):		
Discharged to air	160	=2 percent of model 1,000 MWe LWR with cooling tower.
Discharged to water bodies	11,090	
Discharged to ground	127	
Total	11,377	<4 percent of model 1,000 MWe LWR with once-through cooling.
Fossil fuel:		
Electrical energy (thousands of MW-hour)	323	<5 percent of model 1,000 MWe LWR output.
Equivalent coal (thousands of MT)	118	Equivalent to the consumption of a 45 MWe coal-fired power plant.
Natural gas (millions of scf)	135	<0.4 percent of model 1,000 MWe energy output.
EFFLUENTS—CHEMICAL (MT)		
Gases (including entrainment):[3]		
SO_x	4,400	
NO_2[4]	1,190	Equivalent to emissions from 45 MWe coal-fired plant for a year.

Table S-3.—Continued

Environmental considerations	Total	Maximum effect per annual fuel requirement or reference reactor year of model 1,000 MWe LWR
Hydrocarbons	14	
CO	29.6	
Particulates	1,154	
Other gases:		
F	.67	Principally from UF_6 production, enrichment, and reprocessing. Concentration within range of state standards—below level that has effects on human health.
HCl	.014	
Liquids:		
SO_4	9.9	From enrichment, fuel fabrication, and reprocessing steps. Components that constitute a potential for adverse environmental effect are present in dilute concentrations and receive additional dilution by receiving bodies of water to levels below permissible standards. The constituents that require dilution and the flow of dilution water are: NH_3—600 cfs. NO_3—20 cfs. Fluoride—70 cfs.
NO_3	25.8	
Fluoride	12.9	
Ca^{++}	5.4	
Cl^-	8.5	
Na^+	12.1	
NH_3	10.0	
Fe	.4	
Tailings solutions (thousands of MT)	240	From mills only—no significant effluents to environment.
Solids	91,000	Principally from mills—no significant effluents to environment.
EFFLUENTS—RADIOLOGICAL (CURIES)		
Gases (including entrainment):		
Rn-222		Presently under reconsideration by the Commission.
Ra-226	.02	
Th-230	.02	
Uranium	.034	
Tritium (thousands)	18.1	
C-14	24	
Kr-85 (thousands)	400	
Ru-106	.14	Principally from fuel reprocessing plants.
I-129	1.3	
I-131	.82	
Tc-99		Presently under consideration by the Commission.

Table S-3.—Continued

Environmental considerations	Total	Maximum effect per annual fuel requirement or reference reactor year of model 1,000 MWe LWR
Fission products and transuranics	.203	
Liquids:		
Uranium and daughters	2.1	Principally from milling—included tailings liquor and returned to ground—no effluents; therefore, no effect on environment.
Ra-226	.0034	From UF_6 production.
Th-230	.0015	
Th-234	.01	From fuel fabrication plants—concentration 10 percent of 10 CFR 20 for total processing 26 annual fuel requirements for model LWR.
Fission and activation products	5.9×10^{-6}	
Solids (burned on site):		
Other than high level (shallow)	11,300	9,100 Ci comes from low level reactor wastes and 1,500 Ci comes from reactor decontamination and decommissioning—buried at land burial facilities. 600 Ci comes from mills—included in tailings returned to ground. Approximately 60 Ci comes from conversion and spent fuel storage. No significant effluent to the environment.
TRU and HLW (deep)	1.1×10^{7}	Buried at Federal Repository.
Effluents—thermal (billions of British thermal units)	4,063	<5 percent of model 1,000 MWe LWR.
Transportation (person-rem):		
Exposure of workers and general public	2.5	
Occupational exposure (person-rem)	22.6	From reprocessing and waste management.

[1] In some cases where no entry appears it is clear from the background documents that the matter was addressed and that, in effect, the Table should be read as if a specific zero entry had been made. However, there are other areas that are not addressed at all in the Table. Table S-3 does not include health effects from the effluents described in the Table, or estimates of releases of Radon-222 from the uranium fuel cycle or estimates of Technetium-99 re-

Table S-3.—Continued

leased from waste management or reprocessing activities. These issues may be the subject of litigation in the individual licensing proceedings.

Data supporting this table are given in the "Environmental Survey of the Uranium Fuel Cycle," WASH-1248, April 1974; the "Environmental Survey of the Reprocessing and Waste Management Portion of the LWR Fuel Cycle," NUREG-0116 (Supp. 1 to WASH-1248); the "Public Comments and Task Force Responses Regarding the Environmental Survey of the Reprocessing and Waste Management Portions of the LWR Fuel Cycle," NUREG-0216 (Supp. 2 to WASH-1248); and in the record of the final rulemaking pertaining to Uranium Fuel Cycle Impacts from Spent Fuel Reprocessing and Radioactive Waste Management, Docket RM-50-3. The contributions from reprocessing, waste management and transportation of wastes are maximized for either of the two fuel cycles (uranium only and no recycle). The contribution from transportation excludes transportation of cold fuel to a reactor and of irradiated fuel and radioactive wastes from a reactor which are considered in Table S-4 of § 51.20(g). The contributions from the other steps of the fuel cycle are given in columns A-E of Table S-3A of WASH-1248.

[2] The contributions to temporarily committed land from reprocessing are not prorated over 30 years, since the complete temporary impact accrues regardless of whether the plant services one reactor for one year or 57 reactors for 30 years.

[3] Estimated effluents based upon combustion of equivalent coal for power generation.

[4] 1.2 percent from natural gas use and process.

10 C.F.R. § 51.20(e) (1981).

As of this date the Commission has not finally[5] adopted any explanation of Table S-3, except to the de-

[5] We, of course, are aware that on March 4, 1981, long after this case had been submitted to this court and after respondent had made Table S-3 effective in licensing of additional nuclear power reactors, the Commission did release, by printing in the Federal Register, a *proposed* "Narrative." 46 Fed. Reg. 15154 (Mar. 4, 1981). I understand this term to represent a statement in explanation of the terse and difficult language of Table S-3. Because the Narrative, at present, is proposed and has not been finally adopted by the NRC, it is not ripe for judicial review. However, the Narrative represents the fullest expression of the NRC's most recent findings and thinking concerning the matters comprehended by Table S-3. For this reason, it has been deemed part of the record and considered.

I am unable to understand why this "explanation" (incomplete as it is) was not made available long ago and in ample

gree that such may be found in the footnotes to the Table and in the briefs filed by the Commission.

Turning to the Table itself, the critical language may be found on the fifth from the last line of the Table, which reads:

"TRU and HLW (deep) . . . . 1.1×10^7

Buried at Federal Repository."

Translated into possibly more understandable English, "TRU and HLW" mean transuranic and high level waste. "([D]eep)" is the sole stated explanation of the contemplated storage or disposal of such waste under the Commission's present thinking. The figure 1.1×10 to the 7th power refers to a total of 11 million curies per nuclear reactor per year. In a footnote keyed to the

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time for our present decision. I have proposed to my colleagues on this panel the delay of the release of our decision pending completion of rulemaking on the Narrative, and, understandably, they feel such delay would be inadvisable from the point of view of their court. It seems likely to me, however, that with the issuance of the opinions of this case and the anticipated application for writ of certiorari in the Supreme Court, the Commission will proceed to complete its rulemaking with such modifications of the Narrative as it deems advisable and will then argue that the newly adopted Narrative requires another remand of the case on a claim that the subsequently adopted Narrative has rendered this panel's action moot.

Additionally, we are informed that the NRC has initiated a "waste confidence" proceeding which may update Table S-3. *See* 44 Fed. Reg. 45362, 45363 (Aug. 2, 1979).

Appreciating as I do the complexities and hazards with which respondent is required to deal, I am still compelled to wonder whether the "moving target" aspects of this case have all been required by uncontrollable circumstances or have been in part contrived to frustrate effective judicial review. At oral argument of this case, when a question concerning the "moving target" issue was posed by the author of this opinion, the response was, "Judge, we have able lawyers."

Table Heading, the Commission does elucidate further, as follows:

> In some cases where no entry appears it is clear from the background documents that the matter was addressed and that, in effect, the Table should be read as if a specific zero entry had been made.

Table S-3 n.1.

This innocent sounding language actually stands for the Commission's holding that 11 million curies of high level radioactive waste per year for each of the presently licensed reactors will be temporarily stored, reprocessed, transported, and then buried and contained deep underground at some unascertained place in some undetermined stratum[6] at some undetermined time without any release at all of toxic effluents. The life of presently constructed reactors is estimated to be 30 to 40 years. *See* Proposed Appendix A, Narrative Explanation of Table S-3, 46 Fed. Reg. 15154, 15162 n.2 (Mar. 4, 1981). This means that within the lifetime of the 70[7] presently licensed nuclear power plants, there will be accumulated for disposal at least 2,100 plant-years of radioactive waste, each plant-year representing by Commission estimate 11 million curies.

If the mathematics involved is not sufficiently impressive, it may be appropriate to point out that a "curie" is defined as "a measure of the number of atoms under-

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[6] The as yet unadopted Narrative makes clear that the current staff thinking favors deep layers of bedded salt. *See generally* U.S. NUCLEAR REGULATORY COMMISSION, ENVIRONMENTAL SURVEY OF THE REPROCESSING & WASTE MANAGEMENT PORTIONS OF THE LWR FUEL CYCLE, NUREG-0116 (Oct. 1976).

[7] At the adoption of Table S-3 as a final rule, the NRC listed 70 licensed nuclear power plants. *See* 44 Fed. Reg. 45362, 45370 n.30 (Aug. 2, 1979). That number appears to have changed, however. *See* note 8 *infra* and accompanying text.

going radioactive disintegration per unit time and is 37 billion disintegrations per second, or about the rate of decay in 1 gram of natural radium." C. FOX, RADIOACTIVE WASTES 11 n.* (rev. ed. 1969).

If no other nuclear power plant is licensed or brought on line, the task of the Commission will involve containment in one or more federal repositories of radioactive waste sufficient to generate 854,700,000,000,000,000 (854.7 quintillion) disintegrations per second. Since the decay of radioactive waste spontaneously gives off substantial heat, the problem of preventing accidental or deliberate emission is central to any design that may be proposed for the federal repository. The gradual decay of radioactivity will extend, as the Supreme Court pointed out, from 600 to hundreds of thousands of years. *Vermont Yankee*, 435 U.S. at 538. Yet the Commission contends that this mass of energy and toxic waste (plus possibly two and one-half times more, which may be added by additional nuclear power reactor licensing) can and will be contained with "zero" release. *This must be read as meaning no impact at all on the human race in its turbulent occupancy of this biosphere for a minimum period of 250,000 years.*

THE COMMISSION'S WASTE DISPOSAL PLAN

Licensing of nuclear power reactors began in 1958. Although some 82 licenses have been issued since 1958, several of those plants are no longer operating. At present, 71 reactors are "licensed for operation," although not all are currently on line.[8] The record before us contains published studies of various proposals for handling high-level nuclear waste for over 250,000 years. Many are in conflict. And one important aspect of the Commission's original plan, the reprocessing of spent fuel

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[8] Public information furnished by telephone by the NRC, August 26, 1981.

rods, had been in suspension from 1977 until October 8, 1981.

Originally, the Commission's thinking appears to have encompassed consideration of at least the following elements:

1) Containment buildings for spent fuel rods constructed at each nuclear power plant. These buildings are operated as an integral part of the plant and are guarded within the private power company's perimeter fences. No other temporary, interim, or permanent storage facility for commercial high-level nuclear waste has yet been built.

As a consequence, spent nuclear fuel is currently accumulating in all nuclear power reactor on-site waste storage facilities—in many instances in quantities far in excess of the originally contemplated storage capability. For example, the Vermont Yankee Nuclear Power Station in Vernon, Vermont, a relatively recent entry on the nuclear scene, was designed to store a maximum of 1,000 spent fuel rods. The Vermont Yankee Nuclear Power Corporation has now been given permission by the NRC to store 2,400 such spent fuel assemblies there. It is estimated that the plant can operate only until 1987 under this grant of authority, unless, presumably, some now nonexistent interim or permanent storage facility is provided or authority is granted for the spent fuel rods to be stacked even closer.

2) The NRC's original assumption was that all spent fuel produced by nuclear power reactors would be reprocessed before it was stored. It was also contemplated that the residue of high level waste, particularly plutonium, would be greatly diminished in volume in the process. Only this residue after such extraction was scheduled for storage in the permanent repository. As will be indicated below, this plan is now at least partially back in place.

In fact, a plant for reprocessing spent fuel was built by private industry at West Valley in New York State. It was small; it produced high levels of radioactive effluent releases. *See* 44 Fed. Reg. 45362, 45370 (Aug. 2, 1979). The operation proved to be uneconomical and was abandoned. Three other more sophisticated reprocessing plants—one actually constructed in Barnwell, South Carolina, and the others planned for Oak Ridge, Tennessee, and Marion, Illinois—were contemplated as a basic part of the NRC's nuclear waste disposal plan. This record indicates that thus far no reprocessing of spent nuclear fuel, except in small experimental amounts, has occurred.*

3) The NRC also contemplates an interim storage facility. This was described as a retrievable surface storage facility (RSSF). Scheduled to be built about 1980, the RSSF was thought to be capable of storing high-level waste for up to 100 years. The facility would have been built at ground level or slightly below. The high-level waste was to be placed in canisters capable of containing toxic emissions. The dissemination of heat from the decay processes would be accomplished by bringing containment canisters into contact with a coolant, either water or air. Each canister was then to be stored and subjected to cooling for 100 years in the RSSF before being moved to permanent storage.

No such facility has ever been built.

4) Most Commission documents indicate that all high-level waste ultimately will be placed in a federal repository for permanent disposal. The most frequently cited plan, as indicated earlier, is for deep burial in geologic

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* This case and opinion pertain, of course, to commercial nuclear power. The result in this case, therefore, would not apply to the licensing, construction and operation of military and experimental reprocessing plants.

salt deposits.[10] Studies of salt bed deposits have been made, the results of which the Commission staff regards as favorable to permanent containment.

THE REVIEW STANDARD

The statute under which the Supreme Court has directed us to review this case is the Administrative Procedure Act, 5 U.S.C. §§ 551-59, 701-06 (1976). In applicable part the Act says:

> To the extent necessary to decision and when presented, the reviewing court shall decide all relevant questions of law, interpret constitutional and statutory provisions, and determine the meaning or applicability of the terms of an agency action. *The reviewing court shall—*
>
> (1) compel agency action unlawfully withheld or unreasonably delayed; and
>
> (2) *hold unlawful and set aside agency action, findings, and conclusions found to be—*
>
> (A) *arbitrary, capricious, an abuse of discretion, or otherwise not in accordance with law;*
>
> (B) contrary to constitutional right, power, privilege, or immunity;
>
> (C) in excess of statutory jurisdiction, authority, or limitations, or short of statutory right;
>
> (D) without observance of procedure required by law;
>
> (E) unsupported by substantial evidence in a case subject to sections 556 and 557 of

[10] Other proposed plans for high-level waste disposal include a) deep burial in geologic granite formations, b) burial in clay beds in the bottom of the Pacific Ocean, and c) dispatching canisters of high-level waste into permanent orbit around other planets.

> this title or otherwise reviewed on the record of an agency hearing provided by statute; or
>
> (F) unwarranted by the facts to the extent that the facts are subject to trial de novo by the reviewing court.

Id. § 706 (emphasis added).

The critical language to which the Supreme Court directed our attention, *Vermont Yankee*, 435 U.S. at 535 n.14, is found italicized above. The Supreme Court has unanimously interpreted this language as follows:

> Under the "arbitrary and capricious" standard the scope of review is a narrow one. A reviewing court must "consider whether the decision was based on a consideration of the relevant factors and whether there has been a clear error of judgment. . . . Although this inquiry into the facts is to be searching and careful, the ultimate standard of review is a narrow one. The court is not empowered to substitute its judgment for that of the agency." *Citizens to Preserve Overton Park* v. *Volpe, supra*, at 416. The agency must articulate a "rational connection between the facts found and the choice made." *Burlington Truck Lines* v. *United States*, 371 U.S. 156, 168 (1962). While we may not supply a reasoned basis for the agency's action that the agency itself has not given, *SEC* v. *Chenery Corp.*, 332 U.S. 194, 196 (1947), we will uphold a decision of less than ideal clarity if the agency's path may reasonably be discerned. *Colorado Interstate Gas Co.* v. *FPC*, 324 U.S. 581, 595 (1945).

Bowman Transportation, Inc. v. Arkansas-Best Freight System, Inc., 419 U.S. 281, 285-86 (1974).

This court has repeatedly cited and followed *Bowman* and other Supreme Court authority on the arbitrary and capricious standard:

> It is axiomatic that we may not substitute our judgment for that of the agency. *Citizens to Preserve Overton Park, Inc.* v. *Volpe*, 401 U.S. 402, 416, 91 S.Ct. 814, 28 L.Ed.2d 136 (1971). Yet our review must be "searching and careful," *id.*, and we must ensure both that the Commission has adequately considered all relevant factors, *see id.*, and that it has demonstrated a "rational connection between the facts found and the choice made," *Burlington Truck Lines, Inc.* v. *United States*, 371 U.S. 156, 168, 83 S.Ct. 239, 246, 9 L.Ed.2d 207 (1962).

Home Box Office, Inc. v. FCC, 567 F.2d 9, 35 (D.C. Cir.) (per curiam), *cert. denied*, 434 U.S. 829 (1977). *Accord, United States Lines, Inc. v. Federal Maritime Commission*, 584 F.2d 519, 526 (D.C. Cir. 1978); *Ethyl Corp. v. EPA*, 541 F.2d 1, 34-36 & n.74 (D.C. Cir.) (en banc), *cert. denied sub nom. E. I. duPont de Nemours & Co. v. EPA*, 426 U.S. 941 (1976).

"Zero" Release at the Final Repository

On this issue I am in full agreement with Judge Bazelon's opinion and will add only a few paragraphs in support thereof. I agree that it is arbitrary and capricious for the NRC to close off discussion of the grave problems involved in building a permanent repository for all nuclear waste by categorical determination in Table S-3 that there will be zero releases. As I read this record, neither the Commission nor the Commission staff really defend the zero-release conclusion for any purpose other than to prevent discussion of the issue at licensing hearings. This despite the fact that both Commission and staff recognize that present scientific information strongly suggests that there will be releases of gaseous nuclides during the substantial period of time before the repository is closed. Their studies have shown a probability that transportation and storage canisters designed to contain radiological emissions will corrode and disintegrate in time, releasing their contents. The Commission staff contem-

plates some escape of radionuclides either by gaseous emission or ground water migration. In the proposed Narrative, the Commission staff, at least tentatively, holds that these emissions and migrations will occur "early" in the 250,000-year life of the federal repository and that risks therefrom will be "acceptable." It is not clear whether the risks become acceptable before or sometime during the first 10,000 years of decay.

The following Table depicts the periods of toxicity of just a few of the various isotopes found in the high-level wastes that may be stored in the federal repository:

Element	Half-Life (In years)	Period of Toxicity (In years)
Plutonium-239	24,000	250,000 (approx.)
Strontium-90	28	600-1,000
Cesium-137	30	600-1,000
Technetium-99	210,000	2,000,000 (approx.)

The hope and expectation is really that the impact of the releases will be insignificant on human beings.

Even this last conclusion is subject to very significant uncertainty. As yet undetermined amounts of fissionable materials (markedly reduced, however, if reprocessing is employed) will be emplaced in the repository. In 250,000 years there may be one or more ice ages. *See* 46 Fed. Reg. 15154, 15172 (Mar. 4, 1981). The probability of container corrosion, the certainty of heat from the quintillions of disintegrations of radioactive wastes, the probable contact with ground water, added to the possibility of geologic disturbance by such forces as glacier, earthquake, or volcanic eruption, all tend to create significant uncertainties. The NRC relies on two studies for its conclusion that the uncertainties involved in waste disposal do not mandate that it alter the zero-release value. 44 Fed. Reg. 45362, 45367 n.19, 45368 & n.24 (Aug. 2, 1979). One study is that of the Interagency Review Group, *Report to the President by the Interagency Review Group on Nu-*

clear Waste Management (March 1979) (hereafter IRG Report). The IRG admits, however, that there is a large gap between actual and theoretical capabilities in the technology of nuclear waste disposal. Thus, while the IRG Report may correctly conclude geologic disposal is feasible, it cannot be relied upon to prove that radiological emissions will be zero. The IRG Report concedes as much when it states, "[I]n addition to technical evaluation, a societal judgment that considers the level of risk and the associated uncertainty will be necessary." *Id.* at 42.

In the opening pages of the revised Report, the Group states that safe disposal requires a program "whose resolution will clearly require an unprecedented extension of capabilities in rock mechanics, geochemistry, hydrogeology and long-term predictions of seismicity, volcanism, and climate." *Id.* at 3. It later summarizes, "The risk assessments performed to date . . . have . . . been based on idealized repository characteristics and are subject to significant uncertainties." *Id.* at 45. It then specifically described some of the remaining problems:

> The IRG would like to emphasize, however, that risk assessment computations are needed which are site specific in the origin of their data and in their application and only such assessments can truly apply to a specific site. Some uncertainties about the level of risk will always remain both because of the current state of the methodology of risk assessment and because of its inherent limitations.
>
> Uncertainties associated with risk assessment derive from lack of data, lack of experience, inability to identify all release mechanisms for radionuclides, the natural variability in physical properties of geologic media, and inability to predict long-term geologic and climatic processes and social evolution. All of these uncertainties are neither additive nor of equal significance. An important aspect of the research remaining to be done is to understand how

each enters into the overall uncertainty of the calculation of risk.

Id. at 46.

It concludes that further study of the problem is necessary to reduce uncertainties:

> Significant institutional difficulties are involved in: marshalling the resources and programs capable of accurately detailing site suitability criteria and establishment of standards; thoroughly investigating possible sites; accurately assessing site characteristics in light of the technical criteria; carrying out credible analyses of the risks; obtaining agreement on site selection; getting the facility approved and licensed; providing for careful construction and operation of the repository (including safe transportation and handling of the wastes); mitigating accidents and responding to repository failure if that occurs; and providing adequate, long-term monitoring. The level of difficulty of all these problems could increase with the size of the nuclear waste inventory and its rate of growth. Institutions that can cope on a small scale may fail as the demands placed on them multiply. *The IRG believes that a more detailed analysis of logistical and other institutional problems which would arise out of attempting to manage wastes on the scale require*[d] *should be undertaken.*

Id. at 88 (emphasis added).

The Commission's leap from its hopes for safe containment to its conclusion of zero release is, as Judge Bazelon concludes, arbitrary and capricious.

The Plutonium Issue

The Commission's brief argues that all three of the fuel-cycle rules should be upheld by this court. As previously indicated in this opinion, the Commission has stated that Table S-3 was designed to cover the entire back-end of the fuel cycle. As a consequence, this panel's affirm-

ance of the validity of Table S-3, if certiorari were denied or the case affirmed by the Supreme Court, could be taken by the Commission as final approval of its original and present plans for reprocessing spent fuel, fabricating uranium and plutonium into mixed oxide fuel therefrom, and shipping this fuel to nuclear reactors all over the nation.

A. *Presidential Concern About Reprocessing*

The lethal character of plutonium and its potential for use in nuclear bombs evoked expressions of concern from two successive Presidents, Gerald Ford and Jimmy Carter, about the reprocessing of nuclear waste and the separation of bomb-grade plutonium. This concern resulted in April 1977 in a Presidential statement, issued by President Carter, suspending all NRC plans for reprocessing spent nuclear fuel. This statement reads:

> There is no dilemma today more difficult to resolve than that connected with the use of nuclear power. Many countries see nuclear power as the only real opportunity, at least in this century, to reduce the dependence of their economic well-being on foreign oil—an energy source of uncertain availability, growing price, and ultimate exhaustion. The U.S., by contrast, has a major domestic energy source—coal—but its use is not without penalties, and our plans also call for the use of nuclear power as a share in our energy production.
>
> The benefits of nuclear power are thus very real and practical. But a serious risk accompanies worldwide use of nuclear power—the risk that components of the nuclear power process will be turned to providing atomic weapons.
>
> We took an important step in reducing the risk of expanding possession of atomic weapons through the Non-Proliferation Treaty, whereby more than 100 nations have agreed not to develop such explosives. But we must go further. The U.S. is deeply con-

cerned about the consequences for all nations of a further spread of nuclear weapons or explosive capabilities. We believe that these risks would be vastly increased by the further spread of sensitive technologies which entail direct access to plutonium, highly enriched uranium, or other weapons usable material. The question I have had under review from my first day in office is how can that be accomplished without forgoing the tangible benefits of nuclear power.

We are now completing an extremely thorough review of all the issues that bear on the use of nuclear power. We have concluded that the serious consequences of proliferation and direct implications for peace and security—as well as strong scientific and economic evidence—require

—a major change in U.S. domestic nuclear energy policies and programs; and

—a concerted effort among all nations to find better answers to the problems and risks accompanying the increased use of nuclear power.

I am announcing today some of my decisions resulting from that review.

First, we will defer indefinitely the commercial reprocessing and recycling of the plutonium produced in the U.S. nuclear power programs. From our own experience, we have concluded that a viable and economic nuclear power program can be sustained without such reprocessing and recycling. The plant at Barnwell, South Carolina, will receive neither Federal encouragement nor funding for its completion as a reprocessing facility.

Second, we will restructure the U.S. breeder reactor program to give greater priority to alternative designs of the breeder and to defer the date when breeder reactors would be put into commercial use.

Third, we will redirect funding of U.S. nuclear research and development programs to accelerate our research into alternative nuclear fuel cycles which

do not involve direct access to materials usable in nuclear weapons.

Fourth, we will increase U.S. production capacity for enriched uranium to provide adequate and timely supply of nuclear fuels for domestic and foreign needs. * * *

13 WEEKLY COMP. OF PRES. DOC. 506 (1977) (emphasis added).

The Commission recognized the impact of the Presidential order in a "Memorandum of Decision" issued December 23, 1977. In that memorandum, the Commission announced its decision:

(1) to terminate the GESMO proceeding;

(2) to terminate the proceedings on pending or future plutonium recycle-related license applications, except for—

(a) proceedings on licenses for the fabrication or use of small quantities of mixed oxide fuel for experimental purposes, and

(b) those portions of proceedings which involve only spent fuel storage, disposal of existing waste, or decontamination or decommissioning of existing plants;

(3) to reexamine the above matters after the completion of the ongoing domestic and international studies of alternative fuel cycles, now expected to take about 2 years;

(4) to publish the draft safeguards supplement to the GESMO documents as a staff technical report;

(5) as a consequence of the above decisions, to withdraw the November 1975 policy statement on mixed oxide fuel, 40 Fed. Reg. 53056; and

(6) to reserve for decision, if it arises, the question whether a facility such as the Allied-General

Nuclear Services (AGNS) Nuclear Fuels Plant at Barnwell, South Carolina, may be licensed for experimental and feasibility purposes on a non-commercial basis to investigate processes which support the nation's non-proliferation objectives.

This memorandum provides the reasons for the December 23 decision.

BACKGROUND

The use of mixed oxide fuel has been before the Commission and its predecessor, the AEC, for more than a decade. In 1960, Nuclear Fuel Services (NFS) began a small reprocessing plant at West Valley, New York, which operated from 1966 through 1971. Construction of the AGNS Plant at Barnwell began in 1970 and parts of the plant are now essentially complete. AGNS' application for an operating license is currently before the Commission. In 1973, Westinghouse Electric Corporation (Westinghouse) requested a construction authorization letter for a mixed oxide fuel fabrication plant near Anderson, South Carolina. Finally, Exxon Nuclear Company, Inc., (Exxon) is currently seeking permission to construct a reprocessing plant at Oak Ridge, Tennessee.

The health, safety, and environmental impacts of the wide-scale use of mixed oxide fuel were evaluated in the draft Generic Environmental Statement on Mixed Oxide Fuel, published in August 1974. The draft GESMO prompted many public comments, including a January 1975 letter from the President's Council on Environmental Quality which stressed the need to consider the safeguards aspects of wide-scale plutonium recycle. In May 1975, the Commission announced its provisional intention to supplement GESMO with an analysis of safeguards and to limit interim licensing of recycle-related activities to experimental purposes. 40 Fed. Reg. 20142 (May 8, 1975). Over 200 public comments were received in response. In November 1975, the Commission published a policy statement which announced that safe-

guards alternatives would be a part of the GESMO decision, provided for hearings on the GESMO documents, and stated criteria under which interim licensing of nonexperimental recycle-related activities would be considered. 40 Fed. Reg. 53056 (November 14, 1975), corrected 40 Fed. Reg. 59497 (December 24, 1975). The United States Court of Appeals for the Second Circuit affirmed the Commission's hearing procedures but held that interim licensing of recycle-related activities on a commercial scale violated the National Environmental Policy Act (NEPA). *Natural Resources Defense Council, Inc.* v. *Nuclear Regulatory Commission*, 539 F.2d 824 (1976), vacated and remanded to determine mootness, 434 U.S. 1030 (January 16, 1978).

The final impact statement on health, safety, and the environment was published in August 1976 and associated public hearings began that November. The hearings progressed through questioning of the NRC staff on its testimony and the filing of written testimony by all participants and proposed questions on that testimony.

Congress and other parts of the Federal Government, members of the public, and experts in the national security field have continued to express concerns related to the nuclear weapons proliferation risks of plutonium recycle technology as it is presently conceived. That technology produces separated plutonium, which can be used in the production of nuclear explosives. The concern is basically that the international spread of plutonium recycle technology for commercial nuclear power production creates a risk that nonnuclear weapons states might turn plutonium from the commercial fuel cycle to the production of nuclear explosives. See generally Senate Committee on Government Operations, 94th Cong., 1st. Sess., Peaceful Nuclear Exports and Weapons Proliferation—A Compendium (Comm. Print 1975). Moreover, a decision by the United States to proceed with commercial plutonium recycle domestically would un-

dermine U.S. efforts to restrain premature international resort to plutonium. The risk led the Commission in late summer 1976 to direct its staff to begin an analysis for GESMO for international proliferation risks and safeguards.

On October 28, 1976, President Ford discussed these risks in his Statement on Nuclear Policy, and stated that the nation "should pursue reprocessing and recycling in the future only if they are found to be consistent with our international [non-proliferation] objectives" (p. 4).

President Carter expressed his concern over the proliferation risks of plutonium recycle and the potential availability of other weapons-grade materials in the nuclear fuel cycle in his April 7, 1977, Statement on Nuclear Power Policy. As part of his response to these risks, the President stated that the Administration's policy would be to defer indefinitely domestic plutonium recycle and to initiate a multinational evaluation of alternative fuel cycles in order to promote the government's international nonproliferation goals. The GESMO hearings were indefinitely postponed by the GESMO Hearing Board, and on May 3 the Commission announced that it intended to reassess "the future course and scope of GESMO, the review of recycle-related license applications, and the matter of interim licensing." 42 Fed. Reg. 22964 (May 5, 1977). Public comments were received in June.

On May 5, Marcus Rowden, then Chairman of the Commission, wrote the President requesting his views on these matters. Stuart Eizenstat, Assistant to the President for Domestic Affairs and Policy, responded for President Carter on October 4. The letter (reprinted at 42 Fed. Reg. 57186 (November 1, 1977)) states that "the President believes that his nonproliferation initiatives would be assisted both domestically and internationally if the Commission were to terminate the GESMO proceedings," "terminat[e] . . . staff reviews and hearings relating to recycle

> activities . . . den[y] . . . interim licensing of fuel cycle facilities, den[y] . . . interim licensing for use of mixed oxide fuel in reactors, except in small quantities for experimental purposes," and publish the staff's safeguards supplement.

In re Mixed Oxide Fuel, 7 N.R.C. 711, 713-15 (1978) (emphasis added).

The Commission also recognized that the President's request was due substantial deference and added that there were strong indications of Congressional agreement:

> In addition, it is significant that Congress as a body has not taken any action disagreeing with the President's position on plutonium recycle in light water reactors.[6] Over a year has passed since the President made the deferral of plutonium recycle a matter of national policy and no substantial Congressional opposition has appeared. Indeed, the Congress has in several instances supported the actions the President has taken to implement the Administration's policy. *The Department of Energy Act of 1978—Civilian Applications, Pub. L. No. 95-238, 92 Stat. 47,*[7] *provides $13 million for various activities at the Barnwell Nuclear Fuels Plants related to alternative fuel cycle technologies and the nation's nonproliferation objectives, but "none of the authorized funds may be used for operations of the plant to*

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[6] While Congress has strongly disagreed with the Administration's proposal to discontinue the Clinch River Breeder Reactor project, see note 7, *infra*, that debate has not extended to the deferral of recycle for light water reactors.

[7] At the time of our December 23 decision, an act of the same name and identical in the relevant provisions had been passed by Congress and vetoed by President Carter because of its provisions funding the Clinch River Breeder Reactor. S. 1811, 95th Cong., 1st Sess., §§ 101 (20), 107 (1977); Veto Message from the President, S. Doc. No. 95-73, 95th Cong., 1st Sess. (November 5, 1977). Though vetoed, it indicated Congressional intentions at the time.

process spent fuel from reactors." [8] Sections 101(20), 106.[9] Congress has also explicitly supported the President's alternative fuel cycle studies in Section 105 of the Nuclear Non-Proliferation Act of 1978:

> The President shall take immediate initiatives to invite all nuclear supplier and recipient nations to reevaluate all aspects of the nuclear fuel cycle, with emphasis on alternatives to an economy based on the separation of pure plutonium or the presence of high enriched uranium, methods to deal with spent fuel storage, and methods to improve the safeguards for existing nuclear technology . . . .[10]

In addition, Congress has strongly supported the non-proliferation goals of the Administration's policy. Section 2 of the Nuclear Non-Proliferation Act of 1978 states the following policy:

> The Congress finds and declares that the proliferation of nuclear explosive devices or of the direct capability to manufacture or otherwise acquire such devices poses a grave threat to the security interests of the United States and to continued international progress toward world

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[8] The conferees on the previous vetoed version of the Act, see note 7, *supra*, also indicated their opinion that "the Barnwell facility should be used in such a way as to not to limit the potential for eventual use as a reprocessing plant." H.R. Rep. No. 714, 95th Cong., 1st Sess. 86 (1977).

[9] See also debates on NRC Authorization Act of 1978, S. 1131, 123 Cong. Rec. S8592 (daily ed. May 25, 1977) (remarks of Senator Hart). But see *id.* at S8593 (remarks of Senator McClure).

[10] While the Act did not pass until after our December 23 decision, nearly identical language had been reported out of committee and was before the Senate in October 1977. S. 897, 95th Cong., 1st Sess., § 105. Similar language had passed the House in September 1977. H.R. 8638, 95th Cong., 1st Sess., § 103.

> peace and development. Recent events emphasize the urgency of this threat and the imperative need to increase the effectiveness of international safeguards and controls on peaceful nuclear activities to prevent proliferation. Accordingly, it is the policy of the United States to—
>
> (a) actively pursue through international initiatives . . . the establishment of more effective international controls over the transfer and use of nuclear materials and equipment and nuclear technology for peaceful purposes in order to prevent proliferation . . . .

Moreover, Section 3 states that

> It is the purpose of this Act to promote the policies set forth above by—
>
> (a) establishing a more effective framework for international cooperation . . . to ensure that the worldwide development of peaceful nuclear activities and the export by any nation of nuclear materials and equipment and nuclear technology intended for use in peaceful nuclear activities do not contribute to proliferation . . .

Finally, Section 2(c) strongly endorses the Treaty on the Non-Proliferation of Nuclear Weapons, July 1, 1968, T.I.A.S. No. 6839, the sole function of which is to halt the proliferation of nuclear weapons.[11]

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[11] Language identical to that quoted or referred to in the text had been reported out of committee and was before the Senate in October 1977. S. 897, 95th Cong., 1st Sess., §§ 2(a), (c), 3(a). Language of similar intent passed the House of September 1977. H.R. 8638, 95th Cong., 1st Sess., §§ 2(1), (3), 3(1), (3), (4).

7 N.R.C. at 719-20 (emphasis added).

It is appropriate at this point to take judicial notice of a diametrically opposing point of view expressed by President Reagan:

Nuclear Energy Policy

Statement Announcing a Series of Policy Initiatives. October 8, 1981

A more abundant, affordable, and secure energy future for all Americans is a critical element of this administration's economic recovery program. While homeowners and business firms have shown remarkable ingenuity and resourcefulness in meeting their energy needs at lower cost through conservation, it is evident that sustained economic growth over the decades ahead will require additional energy supplies. This is particularly true of electricity, which will supply an increasing share of our energy.

If we are to meet this need for new energy supplies, we must move rapidly to eliminate unnecessary government barriers to efficient utilization of our abundant, economical resources of coal and uranium. It is equally vital that the utilities—investor-owned, public, and co-ops—be able to develop new generating capacity that will permit them to supply their customers at the lowest cost, be it coal, nuclear, hydro, or new technologies such as fuel cells.

One of the best potential sources of new electrical energy supplies in the coming decades is nuclear power. The U.S. has developed a strong technological base in the production of electricity from nuclear energy. Unfortunately, the Federal Government has created a regulatory environment that is forcing many utilities to rule out nuclear power as a source of new generating capacity, even when their consumers may face unnecessarily high electric rates as a result. Nuclear power has become entangled in a morass of regulations that do not enhance safety but that do cause extensive licensing delays and economic uncertainty. Government has also failed in meeting its responsibility to work with industry to develop an acceptable system for commercial waste disposal, which has further hampered nuclear power development.

To correct present government deficiencies and to enable nuclear power to make its essential contribution to our future energy needs, I am announcing today a series of policy initiatives:

(1) I am directing the Secretary of Energy to give immediate priority attention to recommending improvements in the nuclear regulatory and licensing process. I anticipate that the Chairman of the Nuclear Regulatory Commission will take steps to facilitate the licensing of plants under construction and those awaiting licenses. Consistent with public health and safety, we must remove unnecessary obstacles to deployment of the current generation of nuclear power reactors. The time involved to proceed from the planning stage to an operating license for new nuclear powerplants has more than doubled since the mid-1970's and is presently some 10-14 years. This process must be streamlined, with the objective of shortening the time involved to 6-8 years, as is typical in some other countries.

(2) I am directing that government agencies proceed with the demonstration of breeder reactor technology, including completion of the Clinch River Breeder Reactor. This is essential to ensure our preparedness for longer-term nuclear power needs.

(3) I am lifting the indefinite ban which previous administrations placed on commercial reprocessing activities in the United States. In addition, we will pursue consistent, long-term policies concerning reprocessing of spent fuel from nuclear power reactors and eliminate regulatory impediments to commercial interest in this technology, while ensuring adequate safeguards.

It is important that the private sector take the lead in developing commercial reprocessing services. Thus I am also requesting the Director of the Office of Science and Technology Policy, working with the Sec-

retary of Energy, to undertake a study of the feasibility of obtaining economical plutonium supplies for the Department of Energy by means of a competitive procurement. By encouraging private firms to supply fuel for the breeder program at a cost that does not exceed that of government-produced plutonium, we may be able to provide a stable market for private sector reprocessing and simultaneously reduce the funding needs of the U.S. breeder demonstration program.

(4) I am instructing the Secretary of Energy, working closely with industry and State governments, to proceed swiftly toward deployment of means of storing and disposing of commercial, high-level radioactive waste. We must take steps now to accomplish this objective and demonstrate to the public that problems associated with management of nuclear waste can be resolved.

(5) I recognize that some of the problems besetting the nuclear option are of a deep-seated nature and may not be quickly resolved. Therefore, I am directing the Secretary of Energy and the Director of the Office of Science and Technology Policy to meet with representatives from the universities, private industry, and the utilities, and requesting them to report to me on the obstacles which stand in the way of increased use of nuclear energy and the steps needed to overcome them in order to assure the continued availability of nuclear power to meet America's future energy needs, not later than September 30, 1982.

Eliminating the regulatory problems that have burdened nuclear power will be of little use if the utility sector cannot raise the capital necessary to fund construction of new generating facilities. We have already taken significant steps to improve the climate for capital formation with the passage of my program for economic recovery. The tax bill contains substantial incentives designed to attract new capital into industry.

> Safe commercial nuclear power can help meet America's future energy needs. The policies and actions that I am announcing today will permit a revitalization of the U.S. industry's efforts to develop nuclear power. In this way, native American genius, not arbitrary Federal policy, will be free to provide for our energy future.

17 WEEKLY COMP. OF PRES. DOC. 1101-02 (Oct. 12, 1981).

With this recent Presidential debate in mind, I turn to the possible consequences for this case of President Reagan's announcement on October 8, 1981, which removed all restrictions on nuclear fuel reprocessing.

B. *The NRC Options*

It is, of course, obvious that the NRC has many decisions yet to make in relation to the back-end of the nuclear fuel cycle. It has yet to license a private corporation to build a retrievable surface storage facility, if, indeed, such will ever be built. It has yet to choose a site for its proposed long-term repository. And it has yet to license a commercial reprocessing facility, although it now appears that such will be licensed. Finally, the NRC has not decided whether the reactor fuel to be produced from the reprocessing of spent fuel will be fabricated from 1) uranium only into enriched uranium fuel, 2) uranium and plutonium into mixed oxide fuel, or 3) some other combination of elements not presently described.

The NRC is seeking judicial sanction for the conclusion in the S-3 Tables that any releases that may be produced as a result of the exercise of any of these options can lawfully be termed "zero" or can lawfully be described as "umbrellaed" by the insignificant release figures set forth in the S-3 and S-3A Tables. I see no way by which we can in advance give such sanction consistent with the Administrative Procedure Act and the health and safety requirements of the Atomic Energy Act.

1. *The Uranium-only Recycle Option.* The NRC may decide to adopt a uranium-only recycle plan. This plan contemplates the reprocessing of spent fuel rods and the production of highly enriched uranium. Nonetheless, the extraction and storage of the plutonium remains a problem. The NRC described the option when it promulgated the final version of Table S-3 in August 1979:

> The fuel cycle was to be taken to include . . . reprocessing of spent fuel for purposes other than recycle of plutonium, with follow-on interim and/or long-term storage or disposal of plutonium and wastes from reprocessing, with plutonium either separated from or included with the wastes.

44 Fed. Reg. 45362, 45366 (Aug. 2, 1979) (footnote omitted).

The NRC also envisions that

> [t]he uranium would be converted to uranium hexafluoride for recycling at an enrichment plant. The plutonium, still containing about five percent of the fission products to deter diversion, would be converted to plutonium oxide and packaged for disposal in a Federal waste repository. The high-level liquid waste (HLLW) containing the bulk of the fission products, would be stored up to five years in tanks and then calcined and formed into glass for repository disposal.

Id. at 45369.

This option would, of course, reduce the hazards involved in extracting, storing and transporting plutonium dioxide. This option, however, raises by many degrees the uncertainties involved in the ultimate disposal of the wastes from the spent fuel rods. The remaining plutonium must be handled and guarded at the retrievable surface storage facility. Also, it must be shipped to the long-term waste disposal site and handled and guarded there until the repository is sealed.

Once in the repository, the heat and bulk of the decaying plutonium would increase the thermal stresses on the geologic medium that constitutes the repository. U.S. NUCLEAR REGULATORY COMMISSION, ENVIRONMENTAL SURVEY OF THE REPROCESSING AND WASTE MANAGEMENT PORTIONS OF THE LWR FUEL CYCLE, (NUREG-0116) 4-103 (Oct. 1976). Finally, the existence of large amounts of plutonium buried underground would add to the chance that shifting geologic conditions would cause the inadvertent formation of a critical mass and consequent nuclear explosion. *Id.* at 4-103, 4-104.

Continuation of the no-recycle option would, of course, raise somewhat similar problems.

2. *The Uranium-Plutonium Recycle Option.* The possibility that the NRC might read an affirmance of Table S-3 as justification to proceed with the recycling of plutonium and the fabrication of mixed oxide fuel is particularly troubling. Initially, it is important to note that the NRC has deliberately excluded the risks of nuclear fuel diversion from Table S-3 because it believes those risks are negligible, not because it believes these risks are beyond the scope of this rulemaking. This has been evident throughout the course of the proceeding. For example, when the NRC published its assessment of the risks of the back-end of the light water reactor fuel cycle, NUREG-0116, *supra*, public commentators questioned the exclusion of the risks of accident and sabotage from the interim version of Table S-3. The NRC answered that it excluded those risks because it thought they were negligible:

> *Comment* (CEC B-139): It is unclear whether sabotage impacts have been included in the revised Table S-3.
>
> *Response:* The risks of sabotage are judged to be negligible and therefore no entry is given in Table 2.10 in NUREG-0116. This judgment is based on the required protective measures of physical security, intrinsic protective features of containment systems

> required by regulations, and assessment of radiological consequences of given successful acts of sabotage. The NRC is conducting consequence studies of postulated sabotage events in all fuel-cycle facilities to assess current regulations and possible regulatory improvements as part of its continuing review of the adequacy of present safeguard measures.

U.S. NUCLEAR REGULATORY COMMISSION, PUBLIC COMMENTS AND TASK FORCE RESPONSES REGARDING THE ENVIRONMENTAL SURVEY OF THE REPROCESSING AND WASTE MANAGEMENT PORTIONS OF THE LWR FUEL CYCLE 3-96 (March 1977) (NUREG-0216).[11] After additional hearings on the proposed rule, the NRC Hearing Board expressed the same conclusion:

> As a result of its analyses, the staff concluded that the impacts from accidents would be only a few per cent of the impacts from normal operation and did not include them in the values in Table S-3. . . .
>
> After considering the impacts of sabotage, the staff concluded that, overall, those impacts would be small in comparison with the impacts of normal operation and need not be explicitly included in Table S-3. This conclusion was based on the fact that acts of sabotage tend to resemble accidents. Measures provided to mitigate the effects of accidents should also mitigate the effects of sabotage. Moreover, the Commission now requires that substantial measures be taken to protect nuclear facilities from sabotage, including measures to protect against groups of highly motivated, well-trained saboteurs. We find the staff's conclusion reasonable.

Conclusions and Recommendations of the Hearing Board Regarding the Environmental Effects of the Uranium Fuel Cycle, Docket No. RM 50-3 44-45 (October 26,

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[11] Table 2.10 in NUREG-0116 became part of the basis for Table S-3a in the "Proposed Narrative" of March 1981. *See* 46 Fed. Reg. 15154 (March 4, 1981).

1978); 4 J.A.S. 1466. The NRC adopted the recommendations of the Hearing Board when it promulgated the final version of Table S-3. *See* 44 Fed. Reg. 45362, 45367 (Aug. 2, 1979).[12]

Second, the nuclear regulatory agencies of this country have always contemplated that plutonium recycling would be a part of any fuel reprocessing regime. At 10 C.F.R. § 70.4(m) (1981), which deals with the licensing of reprocessing facilities, we find this definition:

> "Special nuclear material" means (1) plutonium, uranium 233, uranium enriched in the isotope 233 or in the isotope 235, and any other material which the Commission, pursuant to the provisions of section 51 of the act, determines to be special nuclear material
> . . . .

---

[12] I recognize that the closely related Table S-4 allegedly measures the impacts of transportation "of cold fuel to a reactor and of irradiated fuel and radioactive wastes from a reactor." 10 C.F.R. § 51.20(e) n.1. Thus, it may be contended that the risk of plutonium diversion during transportation is not before us for review. Table S-4, however, measures the risk of transporting cold fuel to and radioactive wastes from the reactor, not the larger risks of transporting PuO_2 from reprocessing plants to fuel fabrication plants.

Additionally, the relation of S-3 and S-4 is exceedingly unclear. Table S-3 also contains an entry for transportation effects, and Table S-4 purports to measure "Normal Conditions of Transport" and "Accidents in Transport," not the risks of intentional diversion of nuclear fuel. The NRC has never attempted to clarify this interrelationship. The risks of plutonium recycling are too great to leave a loophole through which the NRC's "able lawyers" could evade review of these hazards.

Finally, the material from NUREG-0216 and the Hearing Board Recommendations, *supra*, indicates that the NRC did not include the risk of diversion in Table S-3 because it thought the risks insignificant, not because it thought the problem outside the scope of Table S-3.

And, the NRC's new regulations dealing with the transportation of nuclear materials also envision the transportation of plutonium.[13] Section 73.2 (aa) defines "[s]trategic special nuclear material" thusly:

> "Strategic special nuclear material" means uranium-235 (contained in uranium enriched to 20 percent or more in the U-235 isotope), uranium-233, or plutonium.

10 C.F.R. § 73.2(aa) (1981).

Accordingly, the NRC could read our affirmance of Table S-3 to support the conclusion that plutonium recycling can be accomplished with zero release and without endangering the public. The NRC believes that "the environmental impacts from reprocessing and related management activities are nearly identical for the recycling of uranium and plutonium and for the recycling of uranium only, as fuel in nuclear power reactors." 46 Fed. Reg. 15154, 15161 (Mar. 4, 1981).[14]

The section of this opinion which follows concerns possible employment of the plutonium option. The NRC may avoid this option because it is clearly the "worst case" in terms of hazards. Or it may adopt it because it appears to be the best option in terms of the economics of the nuclear power industry.

C. *The Plutonium Hazards*

I fear that when the history of this century is written that the greatest debacle of our nation will be

---

[13] The NRC promulgated these regulations in November 1979, well after they terminated the GESMO proceeding. *See* 44 Fed. Reg. 68187 (Nov. 28, 1979).

[14] Also instructive is an alternative version of S-3 which the NRC promulgated during the pendency of the GESMO proceeding. This version of Table S-3 purported to define the impacts of a mixed oxide fuel cycle. Like its successor, this version of Table S-3 neglected the risk of accidental or intentional diversion of plutonium. *See* 41 Fed. Reg. 40506, 40509-510 (Sept. 20, 1976).

> seen . . . to be . . . our creation of vast armadas of plutonium, whose safe containment will represent a major precondition for human survival, not for a few decades or hundreds of years, but for thousands of years more than human civilization has so far existed.
>
> James D. Watson,
> Nobel Laureate, Medicine

On March 13, 1975, Senator Stewart Symington addressed the United States Senate on "Controlling the Cancer of Nuclear Proliferation." His concerns extended well beyond the boundaries of this country and the scope of this case. The following paragraphs, however, serve to illustrate the nature of the problems generated by the recent Presidential decision to lift the prohibition against the NRC's plan to reprocess nuclear waste so as to produce plutonium:

> Only 10 to 20 pounds of plutonium is necessary for making an atomic bomb with the same destructive power as the one dropped on Hiroshima. Yet today, close to 90,000 pounds of plutonium have been produced by commercial nuclear power plants—not including amounts used for the nuclear weapons programs of the Big Powers.
>
> Five years from now some half-million pounds of plutonium may be commercially available throughout the world. As the amount of plutonium grows internationally so does the risk of its diversion from peaceful uses to weapons-development programs.

121 CONG. REC. 6437 (1975).

In present posture, this case requires us to compare the NRC's flat assurance of zero or insignificant release of effluents as stated in Table S-3 with the incredible risks involved in transporting large quantities of plutonium all over the United States.

Plutonium is one of the most deadly substances known to humankind. It is toxic to human beings if a microscopic particle is breathed into the lungs.

> A small quantity of Plutonium-239 smoke deposited in the lung—about one ten-thousandths of an ounce, would kill a person through radiological destruction of lung tissue. A quantity smaller than one one-millionth of an ounce woud give rise to a substantial risk of lung cancer . . . Plutonium-239 . . . is at least 20,000 times more toxic than cobra venom or potassium cyanide and ten times more toxic than heroin or modern nerve gas.

Ford Foundation Energy Policy Project, A TIME TO CHOOSE 210 (1974).

After reprocessing, plutonium is reduced to oxide powders for shipment to fuel fabrication plants:

> NRC regulations prohibit the shipment of plutonium compounds, apart from small quantities, in liquid form. Consequently, the plutonium is converted into the solid dioxide [PuO_2] prior to shipment. Plutonium Oxalate is generally precipitated from the nitrate solution; the oxalate is separated, dried and calcined to form the dioxide. The product is ground and screened to yield a powder of the desired size.

S. GLASSTONE & W. JORDAN, NUCLEAR POWER AND ITS ENVIRONMENTAL EFFECTS 234 (1980).

This powder would be extremely dangerous if dispersed into the air as it could be by accident, theft or sabotage:

> Both in storage and in transit, separated plutonium requires the most careful . . . measures . . . against theft by non-state actors. Owing to the serious inhalation hazard of powdered PuO_2, currently the form in which most nonmilitary stocks are held, equally strict measures for protection of public health and safety are . . . required. These precautions . . . are to be applied from the time the material emerges from the reprocessing plant—at least until . . . it is fabricated into reload fuel assemblies, thereby rendering accounting easier and theft more difficult.

G. I. ROCHLIN, PLUTONIUM, POWER AND POLITICS 90 (1979).

Indeed, even the fabricated mixed oxide fuel would be an attractive target for terrorists. The Nuclear Energy Policy Study Group explained why:

> Shipments of fresh mixed oxide fuel for the yearly reloading of a single reactor would contain enough plutonium for fifty nuclear weapons. Separation of plutonium . . . would be much easier than from irradiated fuel, involving only simple chemical operations and little radiation hazard.

Nuclear Energy Policy Study Group, NUCLEAR POWER: ISSUES & CHOICES 331 (1977) (hereafter NEPSG).

The Study Group pointed out the general, worldwide increase in terrorism over the last decade:

> The past few years have seen an upsurge in the size, sophistication and capabilities of terrorist groups around the world. Terrorist activities offer strongly motivated political or dissident groups a way to dramatize their causes and influence their adversaries . . . the worldwide development of civilian nuclear power provides additional opportunities for terrorists—whether revolutionaries, nationalists, dissidents or criminally motivated—to employ nuclear energy as a weapon. . . .
>
> Terrorists might choose the nuclear industry as a target to exploit the mystique that surrounds nuclear weapons. The threat of nuclear terrorism may be used to extort money, secure the release of prisoners or publicize a particular cause.

Id. at 301.

The simplest form of sabotage would probably consist of blowing up a truck that was transporting plutonium from the reprocessing plant to a fuel fabrication plant or nuclear reactor. A high explosive charge fracturing the shipping container and discharging the oxide powder into the air could occasion disaster to any area downwind.

In addition, plutonium is highly explosive and extremely powerful. It has been estimated that 10 pounds of plutonium fashioned into a bomb could kill 100,000 people in a densely populated city. It has also been estimated by one knowledgeable expert that many thousands of persons in the United States have the knowledge required to design a workable bomb.

With only presently-licensed nuclear reactors taken into account, the NRC's plan for reprocessing nuclear waste would produce 200-300 kilograms (440-660 lbs.) of plutonium from each of 71 reactors, or over 35,000 pounds of this hazardous substance.

On this score the Nuclear Energy Policy Group Study said:

> [T]he weakest link in security would be transportation . . . . The [1973] regulatory changes [to reduce the possibility of employee diversion] did not eliminate the possibility that a small armed group could successfully hold up a truck and hijack its load of nuclear materials . . . . Transport procedures are not vastly different than those employed by armored car companies and other carriers that ship high-value cargo. Some criminal and terrorist groups have already demonstrated capabilities to defeat such precautions.

Id. at 304.

Lovins, Lovins & Ross summarized the present problems of preventing plutonium diversion:

> Political arrangements for safeguards must rest on technical measures for materials accounting and for physical security. The former measures are so imprecise and post hoc that they cannot, even in principle, provide reasonable assurance that many bombs' worth of plutonium per year are not being removed from a good-sized reprocessing plant. Primary reli-

> ance must therefore be placed on physical security measures to limit access . . . These measures must forestall well equipped groups perhaps including senior insiders acting in concert with the host government or a faction of it. Even modestly effective measures would be costly, fallible and intrusive.

Lovins, Lovins & Ross, *Nuclear Power and Nuclear Bombs* 58 FOREIGN AFFAIRS 1137, 1145 (Summer 1980).

The Nuclear Energy Policy Study Group summed up, "If plutonium and highly enriched uranium become increasingly available, the route to national or subnational explosives capabilities will become easier and quicker and safeguards will lose much of their ability to provide reassurance." NEPSG, *supra* at 294.

Commentary on these hazards could be extended indefinitely, since the literature concerning the hazards of plutonium is almost endless.

If this were a wholly peaceful world, or if ours were a wholly peaceful country, the NRC's plan to recycle plutonium and fabricate and burn it as a fuel would be subject to much less objection. In fact, however, the United States confronts many hostile powers, some with vast wealth and the consequent ability to train and arm desperadoes or to bribe and corrupt personnel connected with either private or government aspects of the nuclear cycle. In addition, past history (and in particular the last two decades) teaches that domestic tranquility is a constitutional goal rather than a reality in our land. Organized crime as we know it in our country is capable of hijacking a truck with armed guards, and terrorist groups capable of stopping and robbing Brinks trucks of millions of dollars have demonstrated a somewhat like capability. *See* NEPSG, *supra* at 304.

The routine use of plutonium for nuclear power under the Commission's present plans will call for a private corporation to reprocess the spent fuel rods from all

nuclear reactors, thus producing plutonium. By Commission regulation, that corporation is required to organize a private army larger than has ever existed in this country and to deploy it at the reprocessing plant and on U.S. highways all over the land. *See* 10 C.F.R. § 73.25 (1981). Nevertheless, under the Commission's present plans, it will be impossible to guarantee the security of plutonium shipments from an intelligently organized surprise attack by substantial forces on a lonely stretch of highway in a remote area. Under the Commission's present plans, the ultimate reliance is upon a call to local law enforcement. *See* 10 C.F.R. § 73.26(c)(2)(iii)(A), (i)(6) (1981). In the event of attack at a lonely milepost, the call might produce one deputy sheriff. Protecting plutonium shipments is a task appropriate for the military forces of the United States. No such authorization has been sought from or considered by Congress.

I assume that the theft by stealth or force of sufficient plutonium to fabricate a bomb and its subsequent employment by threats or fact of explosion would constitute a "release." In my view, the threat of such a "release" of plutonium if it is fabricated, stored and shipped all over the nation, is anything but "insignificant." The NCR's finding to the contrary constitutes "a clear error of judgment." *See Citizens to Preserve Overton Park, Inc. v. Volpe*, 401 U.S. 402, 416 (1971). As indicated earlier, I therefore join in holding the affected portions of Table S-3 to be arbitrary and capricious.

The fundamental law that launched this nation on the road to peaceful use of nuclear power was the Atomic Energy Act of 1946, ch. 724, 60 Stat. 755 (1946). That Act was superseded by the Atomic Energy Act of 1954, ch. 1073, 68 Stat. 921 (1954) (codified in 42 U.S.C. § 2011 et seq). The 1954 Act repeatedly requires the "protect[ion] of the health and safety of the public."

42 U.S.C. §§ 2012(d)(e), 2133(b), 2232(a) (1976); *see id.* § 2133(d).

After much acquaintance with this case, I have come to believe that Table S-3, inasmuch as it requires licensing boards to accept that only insignificant releases will result from transporting plutonium all over the nation to 71 (potentially 190) reactors is "otherwise not in accordance with law."

Cost

Appellants New York and Wisconsin contend that the figure of 10% of construction costs per nuclear reactor determined by the NRC as the cost of nuclear waste disposal is arbitrary and capricious. I agree.

As I understand this record, the 10% of cost (building and operating) per nuclear reactor represents the Commission's determination of the economic cost of all nuclear waste disposal. Thus, it underpins the Commission's adoption of the S-3 Tables and is properly before this panel for decision at this time.

This record indicates that the NRC now assumes that all nuclear waste is to be under the guardianship of the federal government practically *in perpetuity* and that all nuclear waste costs above the 10% referred to above for each reactor will be borne by the United States. Under ordinary standards of accountability (absent subsidy determined by law), appropriate charges for maintaining facilities owned and operated by government for private industry would be determined and charged back to the private industry making use of them. The cost of maintenance, surveillance and guarding the public from toxic waste at all such facilities will continue from somewhere between 10,000 and 250,000 years. The currently estimated life of each reactor is 30 years. The nuclear power industry may not survive its problems. Its waste

will, for all practical purposes, survive forever. This policy decision potentially involves an open-ended subsidy of great dimension. Constitutionally, it can only be made as a matter of legislation by Congress and the President. It certainly should not be made sub silentio by an administrative agency and routinely endorsed by the federal courts.

I dissent from my colleagues' treatment of the economic issue. I would remand the issue concerning the economic feasibility of the S-3 Tables to the Commission for further consideration. Public discussion of these costs at licensing hearings should not be terminated until much more knowledge about them has been developed.

OUTLINE

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WILKEY, *Circuit Judge*, dissenting: In *Greater Boston Television Corp.* v. *FCC*[1] the late Judge Leventhal first enunciated what has come to be known as the "hard look" doctrine for judicial review of agency action.[2] When today's case first came to this court (*Vermont Yankee I*), Judge Bazelon upped the ante by endorsing the notion of a "*good*, hard look."[3] Now, notwithstanding clear directions to the contrary from the Supreme Court (in *Vermont Yankee II*),[4] Judge Bazelon has applied a standard which is best described as requiring "too hard a look." If there was ever a doubt prior to today, it is now clear that this court is committed to an assumed role as high public protector of all that is good from perceived evils of the nuclear age.

In his lengthy opinion today (*Vermont Yankee III*) Judge Bazelon adapts to a new heading an approach unanimously rejected by the Supreme Court in *Vermont Yankee II* and steps boldly into the arena of nuclear regulation to vacate all of the NRC's original, interim, and final fuel cycle rules—the product of nearly a decade of agency and judicial proceedings and an administrative record of thousands of pages in length. He justifies this action on a conclusion that the Commission somehow violated NEPA and the APA by adopting a generic table embodying a prediction that nuclear power plant wastes can someday be safely stored.

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[1] 444 F.2d 841 (D.C. Cir. 1970), *cert. denied*, 403 U.S. 923 (1971).

[2] *Id.* at 851-53. *See Pikes Peak Broadcasting Co.* v. *FCC*, 422 F.2d 671, 682 (D.C. Cir.), *cert. denied*, 395 U.S. 979 (1969). *See also infra* pp. 36-38.

[3] *NRDC* v. *NRC*, 547 F.2d 633, 644 (D.C. Cir. 1976) (emphasis added) [hereinafter *Vermont Yankee I* maj. op.].

[4] *Vermont Yankee Nuclear Power Corp.* v. *NRDC*, 435 U.S. 519 (1978) [hereinafter *Vermont Yankee II*].

Judge Bazelon's majority opinion has braided from NEPA, the APA, and his own perceptions of public good a novel standard of substantive and procedural scrutiny of NRC activity which we as a court are unauthorized to create and ill-equipped to manage. It has ignored the Supreme Court's unequivocal mandate that we limit our examination in this matter to the administrative record to determine only whether the NRC's rule was "arbitrary and capricious within the meaning of "§ 10(e) of the Administrative Procedure Act, 5 U.S.C. § 706."[5] On the record before us, which has been supplemented extensively since *Vermont Yankee II*, I cannot say that under the appropriate standard the rule fails. Accordingly, I would affirm.[6]

I. ANALYSIS

The cases before us today represent the latest chapter in perhaps the most celebrated administrative litigation of our time. Although the procedural backdrop of the litigation, adequately rehearsed in Judge Bazelon's opinion,[7] is extraordinarily complex, I believe the analysis and resolution of the central issues are comparatively simple.

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[5] *Vermont Yankee II* at 536 n.14.

[6] I express here only my disagreement with the analysis found in sections III.A.-D. of Judge Bazelon's opinion [hereinafter Bazelon op.] and the disposition found on pages 68-69.

I agree with the analysis under Section III.E. of Judge Bazelon's opinion, affirming the Commission's decisions regarding economic feasibility on the ground that they were not arbitrary and capricious. I question only Judge Bazelon's decision not to apply the same form of the arbitrary and capricious test to the other issues in this case. *See infra* p. 54.

[7] Bazelon op. at 18-28.

That analysis must begin with a review of the case history, culminating in the *unanimous* directive given us by the Supreme Court in *Vermont Yankee II*. Both the holdings and the language of that opinion, essentially endorsing Judge Tamm's original concurrence in *Vermont Yankee I*,[8] clarify the appropriate standard for our review of the informal rulemaking challenged here. When we examine the agency's rulemaking under that standard, two further points become clear. First, the agency acted well within the scope of its broad authority by choosing to consider the issue of long-term risks and uncertainties from radioactive waste disposal *generically*, rather than in a series of repetitive individual power plant licensings. Second, contrary to the majority's joint assertions, the agency did not act arbitrarily and capriciously or "not in accordance with law" by concluding that licensing boards need not factor uncertainties into their environmental analyses, but, that "for the *limited purposes* of the fuel cycle rule it is reasonable to base impacts on the assumption which the Commission believes the probabilities favor": namely, that sites can be found and the technology developed effectively to isolate radioactive waste from the biosphere.[9]

These conclusions are not only compelled by a careful review of the extensively supplemented record on appeal; they are totally consistent with all of the evidence reviewed in Judge Bazelon's opinion. That record clearly reveals that the Commission has fulfilled its proce-

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[8] *NRDC* v. *NRC*, 547 F.2d 633, 658 (D.C. Cir. 1976) (Tamm, J., concurring in result) [hereinafter *Vermont Yankee I* concurrence].

[9] Licensing and Regulatory Policy and Procedures for Environmental Protection, 10 C.F.R. Part 51 (1980), 44 Fed. Reg. 45,362, 45,369 (1979) (emphasis added) [hereinafter Final Rule Statement of Basis and Purpose].

dural obligations under § 102(2)(C) of NEPA [10] and the Administrative Procedure Act,[11] has taken the requisite "hard look" at the waste storage question, and has supported its final rule by "reasoned decisionmaking." This court may require no more.

We easily resolve this appeal if we recognize the obvious—we live in a world of risk, uncertainty, and rapid technological change. We not only expect, we demand, expert agencies charged with broad statutory discretion to make predictions en route to factual, technical, and policy judgments. "Where existing methodology or research in a new area of regulation is deficient, the agency *necessarily enjoys broad discretion* to attempt to formulate a solution to the best of its ability on the basis of available information." [12] So long as the agency adequately observes statutory procedures, gives close scrutiny to all relevant considerations, and engages in reasoned decisionmaking, it is not our job to substitute our judgment for the agency's to reach what we perceive to be the best or correct result. Yet this is precisely what the majority has accomplished in this case.

II. Background

A. The Challenged Rules

The rules at issue here [13] resulted from an informal, "generic" rulemaking instituted by the NRC in November

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[10] 42 U.S.C. § 4332(2)(C) (1976).

[11] 5 U.S.C. § 551 *et seq.* (1976).

[12] *Industrial Union Dep't, AFL-CIO* v. *Hodgson*, 499 F.2d 467, 474 n.18 (D.C. Cir. 1974) (emphasis added).

[13] Petitioners challenge the validity of the original, interim, and final versions of the rule published at 44 Fed. Reg. 45,362 (1979) and codified at 10 C.F.R. §§ 51.20(e) & 51.23(c) (1981). While *Vermont Yankee I* addressed the original rule and *Vermont Yankee II* issued after the interim rule had been promulgated, this is the first case to address the validity of the final rule.

1972 under 5 U.S.C. § 553 of the Administrative Procedure Act.[14] This proceeding, like a number of generic rulemakings noticed by the Commission since 1972,[15] was intended primarily to provide *information* for future adjudications in licensing proceedings. The product of the rulemaking was a table of numerical values (Table S-3), representing the incremental environmental effects associated with the uranium fuel cycle of one additional light water power reactor.[16] Individual licensing boards, in turn, were allowed to factor those representative values into the cost-benefit analysis for each proposed facility as part of the detailed Environmental Impact Statement (EIS) required by § 102(2)(C) of NEPA.[17]

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[14] That section requires only that the agency provide adequate notice of the proposed rulemaking, 5 U.S.C. § 553(b), "give interested persons an opportunity to participate" in the rulemaking, 5 U.S.C. § 553(c), and "[a]fter consideration of the relevant matter presented . . . incorporate in the rule[] adopted a concise general statement of [its] basis and purpose." *Id.*

[15] *See, e.g.*, 39 Fed. Reg. 1001 (1974) (emergency core cooling systems); 40 Fed. Reg. 19,439 (1975) (radiation emissions must be "as low as practicable"); 39 Fed. Reg. 43,101 (1974) (environmental impact of using mixed oxide fuels).

[16] The rule is reproduced in both Judge Bazelon's and Judge Edwards' opinions above.

[17] Section 102(2)(C) requires a "detailed statement" on the environmental impact of major federal actions. As this court recently noted, however, "[t]he EIS . . . is not an end in itself, but rather a means toward the goal of better decisionmaking." *North Slope Borough* v. *Andrus*, 642 F.2d 589, 599-600 (D.C. Cir. 1980). Thus, the decision regarding how much detail to include in an EIS is primarily one for the agency itself, guided by a "rule of reason." *Id.* at 600. *See also Scientists' Inst. for Pub. Information, Inc.* v. *AEC*, 481

Like all generic rulemakings, the proceeding here was instituted to further the goals of administrative efficiency, public participation, and uniformity in agency adjudications.[18] The rulemaking permitted the agency to *consider and settle* in one proceeding a number of issues of fact or policy *common* to a large number of licensing hearings. Without the informal rulemaking, "generic" issues would have been reopened at each proceeding before individual licensing boards. This not only would have required, in proceeding after proceeding, an inefficient presentation of identical and repetitive evidence bearing on matters not truly "local" to the plant proposed for license,[19] but likely would have resulted in inconsistent adjudications.

F.2d 1079, 1091 (D.C. Cir. 1973); *NRDC* v. *Morton*, 458 F.2d 827, 833 (D.C. Cir. 1972). All NEPA demands of an agency is that it give "reasonable consideration to all significant impacts." *North Slope Borough* v. *Andrus*, 642 F.2d 589, 599 (D.C. Cir. 1980).

Although NEPA's own language does not require it, since this court's decision in *Calvert Cliffs' Coordinating Comm.* v. *AEC*, 449 F.2d 1109 (D.C. Cir. 1971), *cert. denied*, 404 U.S. 942 (1972), NRC licensings have included a cost-benefit analysis that "considers and balances the environmental effects of the facility and the alternatives available for reducing or avoiding adverse environmental effects, as well as the environmental, economic, technical and other benefits of the facility." 10 C.F.R. § 51.20(b) (1980).

[18] *See generally* Note, *The Use of Generic Rulemaking to Resolve Environmental Issues in Nuclear Power Plant Licensing*, 61 VA. L. REV. 869, 881-82 (1975).

[19] "Local" issues, unlike generic issues, are particularized and unique issues specific to the construction and operation of a given nuclear power plant and hence, are properly determined in individualized license adjudications. Following the recommendations of the Administrative Conference of the United States and numerous commentators, however, the

B. *Vermont Yankee I*

When this case first came to our court, environmentalist petitioners challenged Table S-3 on the grounds that its values "expresse[d] in numerical terms the conclusion that the environmental effects of the fuel cycle, including [nuclear power] waste disposal, are insubstantial." [20] Judge Bazelon's opinion for the court set aside those portions of the rule pertaining to the issues of high-level waste disposal and waste reprocessing.[21] At the outset the panel majority held, under § 102(2)(C) of NEPA, that "absent effective generic proceedings to consider [long-term waste disposal] issues, they must be dealt with an individual licensing proceedings." [22] Judge Bazelon's opinion for the panel then went on to find the agency's generic proceedings "ineffective" for two interrelated reasons: because the agency's *procedures* were inadequate to "ventilate" thoroughly the waste fuel disposal issues, and because the agency's *record* was inadequate to support its rule.[23] Thus, the issues were relegated to individual adjudication.

NRC began the practice of generic rulemakings because the "practice of resolving generic issues in individual, adjudicatory-style hearings [had] proved a procedural failure when judged by the criteria of efficiency, acceptability, and accuracy." Note, *Judicial Review of Generic Rulemaking: The Experience of the Nuclear Regulatory Commission*, 65 GEO. L. J. 1295, 1301 (1977). *See also* Recommendations of the Administrative Conference of the United States, 1 C.F.R. § 305.73-6 (1977).

[20] *Vermont Yankee I* maj. op. at 646.

[21] *Id.* at 655.

[22] *Id.* at 641.

[23] The majority's two rationales for remand were intertwined to the point of being merged. *Compare* the majority's statement of the issue to be decided:

[Continued]

Judge Tamm, concurring in the result, joined only the second of the court's two grounds, finding that "the *inadequacy of the record* demands that we remand this case to the Commission in order to ensure that it has taken a hard look at the waste storage issue."[24] Challenging Judge Bazelon's first ground of decision, Judge Tamm noted that "the deficiency is not with the *type* of proceeding below, but with the completeness of the record generated."[25] He concluded,

> The appropriate remedy at this point is not to impose ad hoc procedural requirements in an attempt to raise the level of petitioners' participation, *already adequate under* [*5 U.S.C.*] *section 553*, but to remand for. . . the documentation which the majority finds so conspicuously lacking. The Commission should be able to supply the court with a statement of the methods by which its staff arrived at the figures embodied in Table S-3 and by which [the NRC Waste Management Division Director] concluded that the waste storage problem is already technologically and economically soluble. If it cannot, we will have no choice but to invalidate the Commis-

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[23] [Continued]

> we are called upon to decide whether the *procedures* provided by the agency were sufficient to ventilate the issues,

id. at 643 (emphasis added) *with* the panel's final mandate to the Commission:

> *Whatever techniques the Commission adopts,* before it promulgates a rule limiting further consideration of waste disposal and reprocessing issues, *it must in one way or another generate a record in which the factual issues are fully developed.*

Id. at 654 (emphasis added).

[24] *Vermont Yankee I* concurrence at 658 (emphasis added).

[25] *Id.* at 659 (emphasis in original).

sion's rule *under the "arbitrary, capricious" standard*; if it can, we should defer to the administrative weighing of risks and benefits of additional reactors.[26]

C. *Vermont Yankee II*

The Supreme Court unanimously reversed the panel opinion.[27] The united Court, speaking through Justice Rehnquist, resoundingly rejected the first of the panel's decisional grounds:

> [N]othing in the APA, NEPA, the circumstances of this case, the nature of the issues being considered, past agency practice, or the statutory mandate under which the Commission operates permitted the [circuit] court to review and overturn the rulemaking proceeding *on the basis of the procedural devices* employed (or not employed) by the Commission so long as the Commission employed at least the statutory *minima, a matter about which there is no doubt in this case.*[28]

The Court did not, however, reverse this court's second finding, concurred in by Judge Tamm. Instead, it remanded that question to us with the following directive:

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[26] *Id.* at 661 (emphasis added).

[27] Justices Blackmun and Powell took no part in the consideration or decision of the case. *See Vermont Yankee II* at 521.

[28] *Id.* at 548 (emphasis added). While the Court found it "not entirely free from doubt" whether the majority had struck down the rule because of inadequate procedures or because of an inadequate record, *id.* at 541, it eventually concluded that Judge Bazelon's majority opinion had "struck down the rule because of the perceived inadequacies of the procedures employed in the rulemaking proceedings. . . . [W]e feel compelled to address the opinion on its own terms, and we conclude that it was wrong." *Id.* at 541-42.

There remains, of course, the question of whether the challenged rule finds sufficient justification in the administrative proceedings that it should be upheld by the reviewing court. Judge Tamm, concurring in the result reached by the majority of the Court of Appeals, thought that it did not. There are also intimations in the majority opinion which suggest that the judges who joined it likewise may have thought the administrative proceedings an insufficient basis upon which to predicate the rule in question. *We accordingly remand so that the Court of Appeals may review the rule as the Administrative Procedure Act provides.* We have made it abundantly clear before that *when there is a contemporaneous explanation of the agency decision, the validity of that action must "stand or fall on the propriety of that finding, judged, of course, by the appropriate standard of review.* If that finding is not sustainable on the administrative record made, then the Comptroller's decision must be vacated and the matter remanded to him for further consideration." *Camp* v. *Pitts*, 411 U.S. 138, 143 (1973). See also *SEC* v. *Chenery Corp.*, 318 U.S. 80 (1943). The court should engage in this kind of review and not stray beyond the judicial province to explore the procedural format or to impose upon the agency its own notion of which procedures are "best" or most likely to further some vague, undefined public good.[29]

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[29] *Id.* at 549 (emphasis added). In two footnotes to its opinion, the Court elaborated on its general directive. *See id.* at 535-37 n.14:

> Upon remand, the majority of the panel of the Court of Appeals is entirely *free to agree or disagree with Judge Tamm's conclusion that the rule pertaining to the back end of the fuel cycle under which petitioner Vermont Yankee's license was considered is arbitrary and capricious within the meaning of § 10(e) of the Administrative Procedure Act*, 5 U.S.C. § 706 (1976 ed.), even though it may not hold, as it did in its previous opinion, that the rule is invalid because of the inadequacy of the agency procedures. Should it hold the rule invalid, it appears in

The *Vermont Yankee II* Court buttressed its explicit mandate with four observations of major significance to our review on remand. First, the Court reiterated the broad scope of NRC authority to deal with fuel cycle issues by rulemaking.[30] Second, the Court declared that this court had "fundamentally misconceive[d] the nature of the standard for judicial review of an agency rule." [31]

> [Because] informal rulemaking need not be based solely on the transcript of a hearing held before an agency . . . the adequacy of the "record" in this type of proceeding is not correlated directly to the type of procedural devices employed, but rather turns on *whether the agency has followed the statutory mandate of the Administrative Procedure Act or other relevant statutes.*[32]

> all probability that the Commission will proceed to promulgate a rule resulting from rulemaking proceedings currently in progress. . . . In all likelihood the Commission would then be required, under the compulsion of the court's order, to examine Vermont Yankee's license under that new rule.
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> If, on the other hand, a majority of the Court of Appeals should decide that it was *unwilling to hold the rule in question arbitrary and capricious merely on the basis of § 10(e) of the Administrative Procedure Act,* Vermont Yankee would not necessarily be required to have its license reevaluated.

(emphasis added). *See also id.* at 549 n.21.

[30] The Court observed that "[i]n the Court of Appeals no one questioned the Commission's authority to deal with fuel cycle issues by informal rulemaking as opposed to adjudication. Neither does anyone seriously question before this Court the Commission's authority in this respect." *Id.* at 535 n.13 (citations omitted). *See also infra* pp. 38-39.

[31] *Vermont Yankee II* at 547.

[32] *Id.* (emphasis added).

The Court's third observation, particularly important for our purposes today, emphasized the *limited scope* of our power to review NRC rulemaking under NEPA. Justice Rehnquist stated in no uncertain terms that a reviewing court's already-limited power to review the *substance* of agency decisions is *not* significantly supplemented by the broadly stated environmental mandate found in § 101 of NEPA.[33] In *Calvert Cliffs' Coordinating Comm.* v. *AEC*,[34] this court had held that § 101 imposes *substantive* restraints on agency actions, thus obliging courts to review agency decisions on the merits to ensure their consistency with the goals of NEPA.[35] In *Vermont Yankee II* the Court acknowledged that while "NEPA does set forth significant substantive goals for the Nation, . . . its mandate to the agencies is *essentially procedural*." [36] In *Stryckers' Bay Neighborhood Coun-*

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[33] Section 101(a) of NEPA declares in broad language that it is the "continuing policy" of the federal government "to use all practicable means and measures" to achieve a variety of environmental goals. 42 U.S.C. § 4331(a) (1976). Section 101(b) then declares that the Government had the "continuing responsibility . . . to use all practicable means, consistent with other essential considerations of national policy" to achieve those goals. 42 U.S.C. § 4331(b) (1976).

The specific procedural directives found in section 102, including the EIS requirement, *see* note 17 *supra*, are "action-forcing" procedures designed to help implement the broad goals of section 101. *See Kleppe* v. *Sierra Club*, 427 U.S. 390, 409 (1976).

[34] 449 F.2d 1109 (D.C. Cir. 1971), *cert. denied*, 404 U.S. 942 (1972).

[35] *Id.* at 1112-13 & n.5. *See also EDF* v. *Corps of Eng'rs*, 470 F.2d 289, 298 (8th Cir. 1972), *cert. denied*, 412 U.S. 931 (1973).

[36] *Vermont Yankee II* at 558 (emphasis added). The opinion continued by clarifying that the role of NEPA

> is to insure a fully informed and well-considered decision, not necessarily a decision the judges of the Court of

cil v. *Karlen*,[37] the Court elaborated on that statement:

> *Vermont Yankee* cuts sharply against the Court of Appeals' conclusion that an agency, in selecting a course of action, must elevate environmental concerns over other appropriate considerations. On the contrary, once an agency has made a decision subject to NEPA's *procedural* requirements, the *only role for a court is to insure that the agency has considered the environmental consequences;* it cannot " 'interject itself within the area of discretion of the executive as to the choice of the action to be taken.' " [38]

Furthermore, the *Vermont Yankee II* Court explicitly rejected Judge Bazelon's view that NEPA authorizes courts to require agencies to "develop new *procedures* to accomplish the innovative task of implementing NEPA through rulemaking:" [39]

> We have before observed that "NEPA does not repeal by implication any other statute." . . . In fact,

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Appeals or of this Court would have reached had they been members of the decisionmaking unit of the agency. Administrative decisions should be set aside in this context, as in every other, only for substantial procedural or substantive reasons as mandated by statute, . . . not simply because the court is unhappy with the result reached. And a single alleged oversight on a peripheral issue, urged by parties who never fully cooperated or indeed raised the issue below, must not be made the basis for overturning a decision properly made after an otherwise exhaustive proceeding.

Id.

[37] 444 U.S. 223 (1980) (per curiam).

[38] *Id.* at 227-28 (*citing Kleppe* v. *Sierra Club*, 427 U.S. 390, 410 n.21 (1976)) (emphasis added).

[39] *Vermont Yankee II* at 548 (*citing Vermont Yankee I* maj. op. at 653) (emphasis added).

> just two Terms ago, we emphasized that the only procedural requirements imposed by NEPA are those stated in the plain language of the Act. . . . Thus, it is clear *NEPA cannot serve as a basis for a substantial revision of the carefully constructed procedural specifications of the APA.*[40]

Thus, after *Vermont Yankee II*, reviewing courts must not only limit their substantive review of agency action to the appropriate standards under the APA, they must take pains in their *procedural* review to avoid imposing requirements in excess of the "statutory minima" or extending their scrutiny beyond the "plain language" of § 102.

Vermont Yankee II's fourth major pronouncement arose from its discussion of a consolidated case. Addressing *Consumers Power Co.* v. *Aeschliman*,[41] which presented identical fuel cycle issues in the licensing context, the *Vermont Yankee II* Court reiterated both the breadth of NRC statutory authority and the limited "role of a court in reviewing the sufficiency of an agency's consideration of environmental factors" under NEPA.[42] The Court expressly recognized that § 102(2)(C) requires responsible agency officials to include in

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[40] *Id.* (citations omitted) (emphasis added).

[41] No. 76-528, *reversing Aeschliman* v. *NRC*, 547 F.2d 622 (D.C. Cir. 1976).

[42] *Vermont Yankee II* at 555. In *Consumers Power*, opponents of a nuclear power plant had challenged an NRC construction permit on the grounds that the accompanying EIS had failed to consider certain energy conservation alternatives to plant construction, in violation of Council on Environmental Quality (CEQ) regulations. The Commission rejected their challenge for failure to meet a "threshold test"—that the proposed alternatives were as yet "reasonably available." Until the challengers had crossed that threshold, the agency

each EIS "a detailed statement . . . on . . . alternatives" to the proposed federal action[43] and that NEPA obliges agencies to consider "every significant aspect of the environmental impact" of the action.[44] Nevertheless, it refused to read those NEPA requirements as placing on the agency the burden of justifying every decision *not to consider* a highly unlikely alternative to a given action. The initial burden of establishing that an alternative is sufficiently material to require agency consideration, the Court suggested, properly rests with the *challenger* to the agency action.[45] Furthermore, the Court reasoned, even when the challenger has met that burden,

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determined, it was not required to consider their proposed alternatives. *Id.* at 533.

This court, again speaking through Judge Bazelon, had reversed, holding that the NRC's "threshold test" was both arbitrary and capricious and inconsistent with NEPA, *Aeschliman* v. *NRC*, 547 F.2d 622, 629 (D.C. Cir. 1976). Once the challenger had drawn the NRC's attention to an alternative, Judge Bazelon held, the NRC had a duty to investigate that alternative and explain why it did not deserve further consideration, *id.* at 628. Judge Bazelon further found the NRC's Advisory Committee on Reactor Safeguards (ACRS) report evaulating the proposed plant's safety insufficiently detailed to apprise the public of potential health hazards. *Id.* at 630-32. The *Vermont Yankee II* Court reversed both rulings. *Vermont Yankee II* at 555, 558.

[43] *Vermont Yankee II* at 551 (citing 42 U.S.C. § 4332(C)).

[44] *Id.* at 553.

[45] Citing Judge Leventhal's discussion in *Portland Cement Ass'n* v. *Ruckelshaus*, 486 F.2d 375, 394 (D.C. Cir. 1973), *cert. denied*, 417 U.S. 921 (1974), Justice Rehnquist noted that when challengers "are requesting the agency to embark upon an exploration of uncharted territory . . . 'comments must be significant enough to step over a threshold requirement of materiality before any lack of agency response or consideration becomes of concern.'" *Vermont Yankee II* at 553.

the agency's subsequent duty to consider and explore little-known technological alternatives must necessarily be bounded by two practical constraints: the *feasibility* of those alternatives[46] and the extent of *information* about them currently available.[47]

In short, the *Vermont Yankee II* Court's discussion of *Consumers Power* confirmed a view this court has stated several times: that NEPA necessarily allows agencies some flexibility in determining the contents of their environmental impact statements in situations where uncertainty is abundant, technological alternatives are still developing, and much crucial information remains unavailable.[48] In such circumstances, as Judge Wright

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[46] To make an impact statement something more than an exercise in frivolous boilerplate the concept of alternatives must be bounded by some notion of feasibility. . . . Common sense also teaches us that the "detailed statement of alternatives" [required by NEPA] cannot be found wanting simply because the agency failed to include every alternative device and thought conceivable to the mind of man. Time and resources are simply too limited to hold that an impact statement fails because the agency has failed to ferret out every possible alternative. . . .

Id. at 551 (citing with approval *NRDC* v. *Morton*, 458 F.2d 827, 837-38 (D.C. Cir. 1972)).

[47] [T]he concept of "alternatives" is an evolving one, requiring the agency to explore more or fewer alternatives as they become better known and understood. This was well understood by the Commission, which, unlike the Court of Appeals, recognized that the Licensing Board's decision *had to be judged by the information then available to it. And judged in that light we have little doubt the Board's actions were well within the proper bounds of its statutory authority.*

Id. at 552-53.

[48] *See, e.g., North Slope Borough* v. *Andrus*, 642 F.2d 589, 605-06 (D.C. Cir. 1980) (discussing degree of detail necessary to EIS when considerable uncertainties exist):

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noted in *Scientists' Institute for Public Information* v. *AEC*,[49] "NEPA is not a paper tiger, but neither is it a straitjacket."[50]

Vermont Yankee II closed with the unambiguous command that courts should not employ judicial review of NRC action to encroach on fundamental policy choices in the nuclear power arena:

> Nuclear energy may some day be a cheap, safe source of power or it may not. But Congress has made a choice to at least try nuclear energy, establishing a reasonable review process in which courts are to play only a limited role. The fundamental policy questions appropriately resolved in Congress and in the state legislatures are *not* subject to reexamination in the federal courts under the guise of judicial review of agency action. Time may prove wrong the decision to develop nuclear energy, but it

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[48] [Continued]

> The [agency] plainly cannot be expected or required to wait until the totality of environmental effects is known.
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> [This case] presents a record of facts and doubts that have not yet fully matured. . . . Uncertainty over remote hazards can be rectified as more information is collected [necessary to] . . . instruct the [agency] in [its] developing view of costs and benefits. It is more logical and efficient to ask certain questions when the truth of their premises is unveiled.

See also Scientists' Inst. for Pub. Information v. *AEC*, 481 F.2d 1079, 1091-92 (D.C. Cir. 1973) (NEPA requirement that agency describe anticipated environmental effects of proposed action is subject to rule of reason); *NRDC* v. *Morton*, 458 F.2d 827, 837-38 (D.C. Cir. 1972) (NEPA does not require agency to discuss in detail "remote and speculative" alternatives whose environmental effects "cannot be readily ascertained.")

[49] 481 F.2d 1079 (D.C. Cir. 1973).

[50] *Id.* at 1091-92.

is Congress or the States within their appropriate agencies which must eventually make that judgment. In the meantime courts should perform their appointed function.[51]

III. Our Task on Remand

The majority has deviated from a clearly presented path—charted by the Supreme Court itself—to lead this court again on a confusing and unauthorized incursion into a policymaking area reserved by Congress to the NRC. I cannot participate in this trespass.

The Supreme Court's explicit directive in *Vermont Yankee II* was that we first, clarify the nature of the *agency decision* under challenge; second, seek a *"contemporaneous explanation"* of that decision; and third, judge the "propriety of that finding . . . by the *appropriate standard of review.*"[52] A conclusion that the agency's finding was sustainable on the administrative record would effectively end our inquiry.

A. The Agency's Decision

The primary NRC choice still under review is the agency's decision to promulgate the final rule based on the factual record before it. As Judge Tamm noted in his original concurrence in *Vermont Yankee I*, that type of rule "encompass[es] both factual determinations and policy choices."[53] Although the line separating fact and policy has never been hard and fast,[54] we have often

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[51] *Vermont Yankee II* at 557-58.

[52] *See supra* p. 11.

[53] *Vermont Yankee I* concurrence at 661 n.11.

[54] *Compare Ethyl Corp.* v. *EPA*, 541 F.2d 1 (D.C. Cir.) (en banc), *cert. denied*, 426 U.S. 941 (1976), *with id.* at 70

employed the distinction to calibrate the intensity with which we scrutinize an agency's contemporaneous explanation of its decisions.[55] Judge Tamm explained in *Vermont Yankee I* how the distinction has been commonly employed:

> This court has also distinguished between factual determinations and policy choices more peculiarly within the expertise of the administrative agency. In the former case, we commonly have insisted upon sufficient attention to the facts to enable the reviewing court to ascertain the underlying rationality of the resultant regulations. . . . In contrast, "[w]here . . . the regulations turn on *choices of policy*, on an *assessment of risks, or on predictions dealing with matters on the frontiers of scientific knowledge*, we will demand adequate reasons and explanations, but not 'findings' of the sort familiar from the world of adjudication."[56]

Contrary to intimations in the majority opinion[57] none of the specific figures in Table S-3 were intended

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(dissenting opinion) (debating whether dichotomy exists between facts and risks).

[55] *See e.g., Amoco Oil Co.* v. *EPA*, 501 F.2d 722 (D.C. Cir. 1974); *Industrial Union Dep't* v. *Hodgson*, 499 F.2d 467 (D.C. Cir. 1974).

[56] *Vermont Yankee I* concurrence at 661 n.10 (quoting *Amoco Oil Co.* v. *EPA*, 501 F.2d at 741) (emphasis added). Drawing some initial distinctions between the factual and policy determinations made by the NRC in the original rulemaking, Judge Tamm noted that the agency's decisions to treat the waste storage issue generically, to license reactors, and to postpone until later the question of which method of waste storage to adopt were policy or risk assessment judgments reviewable only for "clear abuse of discretion." *Id.*

[57] *See Bazelon* op. at 36-42.

to reflect factual certainties.[58] Rather, they were a series of estimated fuel cycle impacts based on agency predictions, educated guesses, and assumptions about the future, combined with quantitative analysis. As such, they fell squarely into the gray area between "fact" and "policy." When such predictions are asserted as facts based on hard data, with all uncertainties and assumptions underlying them undisclosed, they deserve to be scrutinized as factual determinations. When they are asserted as qualitative risk assessments, however, validly based on agency expertise and the best available information, with underlying uncertainties and assumptions fully exposed, they deserve the greater deference given to agency policy choices.[59] It is impossible to determine when predictions deserve the deference given policy choices and when they deserve the closer scrutiny given facts without assessing the *purposes* for which the predictions were made, the *methodology* by which they were developed, and the *conclusions* they served to support. For this information we must turn to the agency's contemporaneous explanation, as the Supreme Court directed.

B. Contemporaneous Explanation

1. *The Commission's Purpose*

A review of the record reveals that the Commission's expressed purpose in conducting the final S-3 rulemaking

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[58] The majority opinion in effect concedes this, noting that a "factual finding" interpretation of these figures, including the "zero-release" figures, is the less likely of the two possibilities—the other being that the figures were intended only as decisionmaking devices. *Id.* at 42.

[59] Looking to the future, and commanded by Congress to make policy, a rule-making agency necessarily deals less with "evidentiary" disputes than with normative conflicts, projections from imperfect data, experiments and

had evolved considerably since it had conducted the original rulemaking.[60] Its expressed purpose in conducting

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simulations, educated predictions, differing assessments of possible risks, and the like. The process is *quasi*-legislative in character.

Amoco Oil Co. v. *EPA*, 501 F.2d 722, 735 (D.C. Cir. 1974). *Accord, Ethyl Corp.* v. *EPA*, 541 F.2d 1 (D.C. Cir.) (en banc), *cert. denied*, 426 U.S. 941 (1976) (holding that agency may promulgate rules based on qualitative appraisal of risk when scientific knowledge provides no answer to crucial issues of fact).

[60] The original S-3 rulemaking record on waste management and reprocessing consisted solely of a twenty-page statement by the Director of the AEC's Division of Waste Management professing confidence that long-term waste disposal would someday be achieved. *See Vermont Yankee I* maj.op. at 647-51. Although the Commission had concluded almost without reflection that waste disposal would contribute insignificantly to the overall environmental effects of the fuel cycle, it permitted no further discussion of those effects in individual proceedings beyond use of Table S-3 itself.

In the wake of *Vermont Yankee I* however, the Commission reopened the rulemaking proceeding to supplement the record on waste reprocessing and management. 41 Fed. Reg. 34,707 (1976). The Commission Staff produced an extensive report entitled ENVIRONMENTAL SURVEY OF THE REPROCESSING AND WASTE MANAGEMENT PORTIONS OF THE LWR FUEL CYCLE (NUREG-0116 (1976)) [hereinafter NUREG-0116]. That Survey discussed gaps in existing information about waste management assessment, made educated, conservative estimates of release levels, and included discussions of those waste management technologies currently available. 42 Fed. Reg. 13,805 (1977). The Commission also acknowledged for the first time that uncertainties existed with respect to risks from long-term repository failure. 41 Fed. Reg. 45,849-45,850 (1976). The Commission promised to consider new data in its analysis as it became available. *Id.*

At the same time, the Energy Research and Development Administration (ERDA) began preparation of a generic en-

the final rulemaking was not to evaluate or select the most effective long-term waste disposal technology, to model precisely all of the fuel cycle impacts from a single reactor, or even to evaluate the likelihood that the nuclear waste could safely be stored in the long term.

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vironmental impact statement on high-level waste management, a study of repository sites, and a study of interim waste storage plans, including waste solidification. In March 1978 President Carter established an Interagency Nuclear Waste Management Task Force to coordinate the activities of the various agencies conducting long-term waste research, with the ultimate goal of establishing a comprehensive federal program for long-term waste management. 43 Fed. Reg. 53,262 (1978). After hearings, that Task Force issued a report concluding that "there is no scientific or technical reason that would prevent selection of a suitable site for a waste depository." NUCLEAR REG. REP. (CCH) No. 190, at 4 (16 Mar. 1979). *See generally* U.S. DEP'T OF ENERGY, REPORT TID-29442, REPORT TO THE PRESIDENT BY THE INTERAGENCY REVIEW GROUP ON NUCLEAR WASTE MANAGEMENT (1979).

Congress has also stayed abreast of the long-term waste storage problem since *Vermont Yankee I*. For a partial listing of Congressional hearings on spent fuel storage and nuclear waste disposal, see *Hearings on Pub. Works and Energy Research Appropriations, FY 1978, Senate Appropriations Comm.*, Part 5, 95th Cong., 1st Sess. 397, 518, 548 (1977); *Hearings on FY 1979 Budget Review Before the Senate Comm. on Environment and Pub. Works*, 95th Cong., 1st Sess. 473-482, 505, 523 (1978); *Hearings on Energy and Water Dev. Appropriations, Senate Appropriations Comm.*, 1980 (H.R. 4388)—Part 3, 96th Cong., 1st Sess. 402, 517, 647 (1979); *Hearings on Nuclear Waste Disposal Before the Senate Subcomm. on Nuclear Regulation*, 96th Cong., 2nd Sess. 20, 60-234 (1980); *Hearings on H.R. 6390 Before the House Subcomm. on Energy and the Environment*, 96th Cong., 2d Sess., 18 March 1980 (testimony of Chairman Ahearne); *Oversight Hearings on Nuclear Waste Facility Siting Before the House Subcomm. on Energy and the Environment*, 96th Cong., 1st Sess. 3, 71 (1979); *Hearings on Nuclear Waste Facility Siting Before the House Subcomm. on Energy and Power*, 96th Cong., 1st Sess. 3, 71-88 (1979); *Hearings on H.R. 7418 Before the House Subcomm. on Energy Research and Production*, 96th Cong., 1st Sess., 29 May

The NRC's statement of basis and purpose for its "final" S-3 rule made clear that creation of an S-3 table had become only one part of an *ongoing* and *wide-ranging* Commission effort to evaluate long-term nuclear waste disposal issues. The Commission began by noting that "a general update of the rule with respect to all aspects of the uranium fuel cycle" was in progress.[61] It further noted its intent to conduct a supplementary rulemaking directed at producing and incorporating into the final rule an "explanatory narrative" summarizing in understandable terms the environmental significance of the table's numerical impact values.[62] Finally, the Com-

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1980 (testimony of John G. Davis, Deputy Director of Nuclear Material Safety and Safeguards, NRC).

Finally, numerous states and localities have begun to regulate in the area of long-term nuclear waste management. *See generally* Note, *Nuclear Waste Management: What the States Can Do*, 1 VA. J. NAT. RESOURCES LAW 103 (1980) (describing state efforts). Before leaving office, President Carter took steps toward establishing a comprehensive Radioactive Waste Management Program in which state and local governments would play a key role in developing and implementing short- and long-term management programs. *See* Exec. Order No. 12,192 (12 Feb. 1980); *see also* 16 WEEKLY COMP. OF PRES. DOC. 296-301 (12 Feb. 1980).

In sum, since the original S-3 rule was first challenged in this court, the problem of long-term waste disposal—a problem little understood or studied in the early 1970's—has become a major concern of several federal agencies, Congress, the President, and the states, all of whom are bent on finding a long-range solution to the permanent disposal problem.

[61] Final Rule Statement of Basis and Purpose at 45,362.

[62] *Id.* The Commission announced that the narrative would seek to explain both the environmental significance of the release values in the table as well as "important fuel cycle issues now outside the scope of the Table, including socio-economic and cumulative impacts, where these are appro-

mission noted its intent to conduct a parallel generic proceeding—a "waste confidence" proceeding, now in progress—to "consider the most recent evidence regarding the likelihood that nuclear waste can be safely disposed of and when that, or some other off-site storage solution, can be accomplished." [63]

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priate for generic treatment." *Id.* On 4 March 1981 the Commission submitted a version of the narrative for public comment as a proposed amendment to the final fuel cycle rule. *See* 46 Fed. Reg. 15,154 (1981). *See also* note 66 *infra.*

[63] Final Rule Statement of Basis and Purpose at 45,363. Since *Vermont Yankee II*, the courts as well as the agencies had been active in the area of long-range waste disposal. *Cf.* note 61 *supra.* In mid-1978, the Second Circuit held in *NRDC* v. *NRC*, 682 F.2d 166 (2d Cir. 1978) that the Atomic Energy Act did not require the NRC either to condition its licenses on the availability of a method for permanent disposal of high-level radioactive wastes or to conduct a rulemaking to determine whether permanent waste disposal would be possible without undue risk to public health and safety. The Second Circuit concluded that the congressional intent underlying the Act would be satisfied so long as the Commission found "reasonable assurance" that a safe method for permanent waste disposal would be available when needed. *Id.* at 171-75.

Shortly thereafter, in *Minnesota* v. *NRC*, 602 F.2d 412 (D.C. Cir. 1979), this court upheld an NRC decision allowing two plants to expand their on-site storage of high-level wastes, in the process unequivocally reaffirming the Commission's power to "consider the complex issue of nuclear waste disposal in a 'generic' proceeding." *Id.* at 416-17. This court remanded for further consideration, however, the question "whether there is reasonable assurance that an off-site storage solution will be available by the years 2007-09" (the expiration dates of the plant licenses being challenged in that case).

In response to that decision, the NRC has been conducting a generic "waste confidence" proceeding, to "assess generically the degree of assurance now available that radioactive waste can be safely disposed of, to determine when such disposal or off-site storage will be available, and to determine whether radioactive wastes can be safely stored on-site" until off-site storage is available. 44 Fed. Reg. 61,372 (1979). While regarding the "waste confidence" issue as separate

Accordingly, the Commission's statement of basis and purpose referred again and again to the final rule's "limited purpose": to provide a table modeling some, but not all, of the fuel cycle impacts for a typical reactor: [64]

> The table of impacts adopted as a final rule in this proceeding serves as an *important first step* in this consideration, relieving adjudicatory boards from the need to determine those numerical impacts of the uranium fuel cycle which have been extensively considered in generic rulemaking.[65]

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and different in scope and purpose from either the S-3 rulemaking, the general S-3 update, or the S-3 narrative rulemaking, the NRC intends to use the waste confidence proceeding to review and update the S-3 proceeding's conclusions regarding waste disposal. 44 Fed. Reg. 45,363.

In that proceeding, the Department of Energy has filed a lengthy initial statement reviewing the state of the art on permanent waste disposal, estimating that a geological waste repository can be achieved around the year 2000. *See* DOE-NE-0007, "Statement of Position of the USDOE, In the Matter of Proposed Rulemaking on the Storage and Disposal of Nuclear Waste (Waste Confidence Rulemaking)" (15 Apr. 1980). The positions of the more than fifty participants in the proceeding have now been summarized in *Report of the NRC Working Group on the Proposed Rulemaking on the Storage and Disposal of Nuclear Wastes* (29 Jan. 1981). Comments on that study, which identifies information gaps and issues still in controversy, are currently being solicited from the rulemaking participants.

[64] *See* Final Rule Statement of Basis and Purpose at 45,363:

> The rule need not be comprehensive in scope to be a useful and valid exercise of rulemaking authority. A record is not yet available to support a *comprehensive* rule dealing with *all* generic aspects of fuel cycle impacts relevant to reactor licensing, but the Commission is free to adopt a narrower rule that for the present leaves some of these matters for consideration in individual proceedings.

(emphasis added).

[65] *Id.* (emphasis added).

Because individual licensing boards would incorporate the table into environmental cost-benefit analyses where costs would be measured in terms of the *impact* of effluent releases on *human lives*, not in terms of the effluent releases alone, the Commission expressly stated that "use of the table in individual licensing will not foreclose discussion of the *significance*" of the release values stated in the table, or of "other important aspects of the fuel cycle *not* addressed by the table." [66]

In short, the Commission's goal was not to produce an exhaustively comprehensive table of precisely accurate figures as to which all uncertainty had been eliminated. Indeed, had the Commission set that goal as the objective of the rulemaking it could never have produced a Table S-3 at all, since *all* of the figures stated there were based on some unprovable assumptions, predictions, and generalizations. The Commission candidly acknowledged that its rulemaking "necessarily involve[d] a wide-ranging inquiry and a certain amount of speculation." [67] Nevertheless, the Commission chose as a matter of policy

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[66] *Id.* (emphasis added). In its proposed explanatory narrative, the Commission now expresses the conclusion "that the fuel cycle impacts addressed by Table S-3 cannot significantly affect the cost-benefit balance for a light water reactor." 46 Fed. Reg. 15,154, 15,155 (1981) (emphasis added). Based on that conclusion, the Commission has proposed that, once the narrative is formally adopted as part of the final rule, "no further consideration of fuel cycle impacts addressed by Table S-3 and the explanatory narrative will be required or allowed in individual reactor licensing proceedings." *Id.* If supported by the supplementary rulemaking record, the Commission's finding of "no significant effect" would relieve the NRC of any responsibility under NEPA to consider fuel cycle impacts in future licensing adjudication. For the purposes of our review today, however, I make reference only to the *contemporaneous* explanation offered by the Commission in support of its table, namely, the Statement of Basis and Purpose issued in 1979.

[67] Final Rule Statement of Basis and Purpose at 45,363.

not only to acknowledge that uncertainty, but to accept it, and then to proceed in the face of that uncertainty.[68]

The Commission gave two reasons for creating an admittedly imperfect table of model fuel cycle impact values: its concern that NEPA cost-benefit analysis demanded a prelicensing assessment of the environmental effects of the fuel cycle, generic to all licensing actions; and its determination that such assessment lay beyond the expertise of individual licensing boards:

> A study of fuel cycle impact thus involves difficult generic analysis and prediction well outside the normal scope of facility-specific subjects dealt with by a reactor licensing board. *This does not mean the subject can be ignored or deferred until the fuel cycle facilities themselves come up for licensing.* It does mean that in reactor licensing fuel cycle impacts should be treated where possible by generic rulemaking rather than case-by-case adjudication.[69]

Aware that individual licensing boards would rely heavily on the table in future adjudications, however, the Commission deliberately selected its values so that, taken as a whole, the table would reflect "substantial conservatism."[70] So long as the table as a whole was conservative, the Commission assumed, it would adequately serve as a *starting point* in individual environmental cost-benefit analyses, even if not perfectly detailed and precise.

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[68] "A reasonable degree of uncertainty is unavoidable *and is acceptable*, given that basic decisions have not yet been made regarding reprocessing and the technology of waste disposal." *Id.* (emphasis added).

[69] *Id.* (emphasis added).

[70] *Id.* at 45,364.

2. *The Commission's Methodology*

To derive a conservative table of useable estimates amidst uncertainty about future technology, the NRC staff had to select some methodology. The staff chose to analyze intensively the most credible long-term waste disposal method then known—burial of the wastes in a bedded-salt geologic repository several hundred meters below ground—then "estimate[d] its impact conservatively, based on the best available information and analysis."[71] Because such a repository had not yet been built, the staff had to make a number of preliminary assumptions *even to begin analysis.* At the outset, it assumed that an appropriate salt deposit site would be found[72] that the particular salt formation chosen would likely remain essentially undisturbed for millions of years,[73] and that whatever repository built would be designed, operated, and regulated in such a way as to minimize the possibility of long-term failure.[74]

The staff then analyzed the possibility of a repository failure resulting from two types of events: (1) commonplace occurrences, such as long-term corrosion of waste cannisters and subsequent leakage into the groundwater;[75] and (2) unusual occurrences, such as violent

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[71] *Id.* at 45,363.

[72] *Id.* at 45,368 & n.22 (noting that salt deposits have been found in 24 of the 50 states). *See also* NUREG-0116 at 4-73 & Ref. 53 (showing locations of significant rock-salt deposits in continental United States).

[73] Final Rule Statement of Basis and Purpose at 45,368 n.21 (noting that geologic formation of existing salt beds have remained undisturbed for many millions of years already). *See also* NUREG-0116 at 2-11.

[74] *See* NUREG-0116 at 4-77 to 4-79 (showing probable layout of bedded salt repository and describing how provisional repository would be converted to permanent repository).

[75] *Id.* at 4-86 to 4-88.

disruption of the repository by sabotage or natural catastrophe.[76] Having thereby established a range of probabilities for potential waste release based on a variety of repository failure scenarios, the staff then used two approaches to assess the consequences to human life of a waste release: a "hazard index" [77] and a modeling of waste transport to the human environment.[78] Throughout the staff's analysis, working assumptions were expressly spelled out and *uncertainties inherent in the models employed were candidly acknowledged.*[79]

3. *The Commission's Conclusions*

The Commission reiterated the staff's assumptions and uncertainties in its statement of basis and purpose.[80] Based on the record compiled by the staff and hearing board, the Commission then found that the

> characteristics of a bedded-salt repository afford a reasonable basis for the staff's conclusion that the repository can maintain its integrity, provided that sites meeting the selection criteria can in fact be found and developed.[81]

While agreeing "that areas of uncertainty remain regarding both the likelihood of finding a site and the probability that it will perform as expected," [82] the NRC noted that more precise evaluation and selection of the

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[76] *Id.*

[77] *Id.* at 4-88 to 4-89.

[78] *Id.* at 4-89 to 4-94.

[79] *See, e.g., id.* at 4-94 (listing remaining areas of uncertainty).

[80] *See* Final Rule Statement of Basis and Purpose at 45,367-69.

[81] *Id.* at 45,368.

[82] *Id.*

"best" waste disposal technology were properly the subject of *other* NRC proceedings.[83]

Then and only then did the Commission consider whether admitted uncertainties regarding the likelihood of successful waste disposal "can or should be reflected explicitly in the fuel cycle rule":

> On the individual reactor licensing level, *where the proceedings deal with fuel cycle issues only peripherally*, the Commission sees no advantage in having licensing boards repeatedly weigh for themselves the effect of uncertainties on the selection of fuel cycle impacts for use in cost-benefit balancing. *This is a generic question properly dealt with in this rulemaking* as part of choosing what impact values should go into the fuel cycle rule. The Commission concludes, *having noted that uncertainties exist*, that *for the limited purposes of the fuel cycle rule* it is reasonable to base impacts on the assumption which the Commission believes the probabilities favor, *i.e.*, that bedded-salt repository sites can be found which will provide effective isolation of radioactive waste from the biosphere.[84]

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[83] *Id.* at 45,368-69. The Commission noted that the Department of Energy would make the initial judgment regarding which waste disposal technology to select, and that any NRC judgments regarding the likelihood of successful long-term waste disposal would be made in the waste confidence proceeding. *See* note 64 *supra*.

[84] *Id.* at 45,369 (emphasis added). The Commission's statement that it sees "no advantage in having licensing boards repeatedly weigh for themselves the effect of uncertainties on the selection of fuel cycle impacts" is clearly consistent with the rule's statement that licensing boards "shall not be *required*" to consider generic uncertainties. No fair reading of the Commission's stated intent at this time supports Judge Bazelon's conclusion that "the Commission's final Rule, like its two predecessors, does not *permit* licensing boards to consider either the risk that permanent waste management facilities will not be developed, or the risk that they will fail to perform as intended if they are developed." Bazelon op. at 28 (emphasis added).

Based on staff findings of extremely low probabilities of repository failure from either commonplace occurrences or accidental intrusions and an assumption that all volatile radioactive products would be released from a repository before final sealing, the Commission found "that taking post-sealing releases as zero does not significantly reduce the overall conservatism of the table." [85] In concluding that the model chosen by the staff to assess waste disposal impacts was reasonable and adequate for the purposes of the rule, the Commission in no way foreclosed reassessment of its conclusions in light of new evidence. Observing that the "current rate of growth of knowledge [in this area] is very large," [86] the NRC reiterated that "[a] continuing reassessment of the Commission's views on waste disposal is part of the commitment which the Commission has made to Congress." [87]

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[85] Final Rule Statement of Basis and Purpose at 45,369. The staff had evaluated two types of unusual occurrences which might cause accidental breach of repository containment: natural rapid events uninfluenced by humans, such as meteor strikes, and unexpected human intervention, such as sabotage or random drilling. The first type of unusual occurrence, the staff found, would likely occur only once every 50 trillion years. As for the second type of unusual occurrence, the staff found evidence that even a surface burst of a 50-megaton nuclear weapon was unlikely to breach a repository buried at 600-meter depth, and that random drilling would cause repository breach only once in 2500 years. *See* NUREG-0116 at 4-87.

With respect to the more commonplace form of repository breach—gradual erosion and infiltration of the repository by the surrounding groundwater—the staff's major finding was that bedded salt is an enormously plastic, highly impermeable medium. *Id.* at 4-75. So long as the repository was located in a setting known to have little contact with circulating groundwater, the staff reckoned that hundreds of thousands of years could elapse before leached radionuclides would migrate to a well or surface discharge point, exposing humans to radiation via the food chain. *Id.* at 4-89 to 4-93.

[86] Final Rule Statement of Basis and Purpose at 45,369 n.27.

[87] *Id.* at n.26.

C. The Appropriate Standard of Review

The agency action challenged here was an informal generic rulemaking. Under 5 U.S.C. § 706 of the Administrative Procedure Act, which governs judicial review of agency action, the well-established standard for our review of that action is whether the agency decision was "arbitrary, capricious, an abuse of discretion, or otherwise not in accordance with law." [88] That is the

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[88] 5 U.S.C. § 706, governing scope of review, provides,

> To the extent necessary to decision and when presented, the reviewing court shall decide all relevant questions of law, interpret constitutional and statutory provisions, and determine the meaning or applicability of the terms of an agency action. The reviewing court shall—
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> (1) compel agency action unlawfully withheld or unreasonably delayed; and
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> (2) hold unlawful and set aside agency action, findings, and conclusions found to be—
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> (A) arbitrary, capricious, an abuse of discretion, or otherwise not in accordance with law;
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> (B) contrary to constitutional right, power, privilege, or immunity;
>
> (C) in excess of statutory jurisdiction, authority, or limitations, or short of statutory right;
>
> (D) without observance of procedure required by law;
>
> (E) unsupported by substantial evidence in a case subject to sections 556 and 557 of this title or otherwise reviewed on the record of an agency hearing provided by statute; or
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> (F) unwarranted by the facts to the extent that the facts are subject to trial de novo by the reviewing court.
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> In making the foregoing determinations, the court shall review the whole record or those parts of it cited by a party, and due account shall be taken of the rule of prejudicial error.

standard which Judge Tamm expected,[89] and the Supreme Court directed [90] us to use in evaluating the agency's decision. Although it is also the standard which the majority purports to use, a careful reading of their opinion reveals that they have paid it lip service only. The approach actually adopted results in a judgment-substituting analysis which not only exceeds the limits of proper judicial review but which denies the presumption of regularity normally accorded an agency's action.

In *Citizens to Preserve Overton Park* v. *Volpe*,[91] the Supreme Court described the appropriate focus of judicial review under § 706 by essentially consolidating the various overlapping standards listed in § 706(2)(A), (B), (C) and (D) under a single heading—"arbitrary, capricious, or an abuse of discretion"—under which it distinguished three necessary inquiries.[92] First, the Court held, a reviewing court is "required to decide whether the [agency] acted within the scope of [its] authority. This determination naturally begins with a delineation of the scope of the [agency's] authority and discretion." [93] Implicit in this determination is an assessment of the range of choices delegated by Congress to the agency's discretion and a decision whether the agency's action can reasonably be said to fall within that range of choices.

A second directive found in *Overton Park* was that reviewing courts carefully determine whether the agency's actions have followed the "necessary *procedural* requirements." [94] In this case, those requirements are found in

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[89] *See supra* p. 9-10.

[90] *See supra* p. 11.

[91] 401 U.S. 402 (1971).

[92] The separate standards under § 706(2)(B)-(D) thus have been rendered largely redundant by a broad reading of (A)'s "arbitrary, capricious, an abuse of discretion, or otherwise not in accordance with law."

[93] 401 U.S. at 415-16.

[94] *Id.* at 417 (emphasis added).

both the relatively loose notice-and-comment procedures of § 553 of the Administrative Procedure Act[95] and the disclosure requirements of NEPA.[96]

Finally, *Overton Park* held that the court must engage in a limited *substantive* review of the agency's actual decision. Even if an agency has made a decision Congress has empowered it to make, has accorded the parties "administrative due process" by observing all required procedures, and has supported its decision with some evidence,[97] the court must still assure itself that

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[95] 5 U.S.C. § 553 (1976), *discussed in* note 14 *supra*.

[96] 42 U.S.C. § 4332(2)(C) (1976), *discussed in* note 17 *supra*.

[97] When the matter under review arises in the context of a trial-type proceeding conducted under 5 U.S.C. §§ 556-57, a reviewing court must ensure that the agency decision was supported by "substantial evidence" based on the record as a whole. *See* 5 U.S.C. § 706(2)(E), *reprinted in* note 88 *supra*. Some statutes also require that agency *rulemakings* conducted under the statute be supported by substantial evidence. *See, e.g., Mobil Oil Corp.* v. *FPC*, 483 F.2d 1238 (D.C. Cir. 1973) (discussing Natural Gas Act).

Judicial review of the agency's evidentiary record in an informal rulemaking like this one, however, must be guided by the "arbitrary [and] capricious" standard of 5 U.S.C. § 706(2)(A). There is little doubt that the NRC's extensive evidentiary record here satisfies that test since the arbitrary and capricious standard is even less stringent than the lenient "substantial evidence" standard of review. *See* Wright, *The Courts and the Rulemaking Process: The Limits of Judicial Review*, 59 CORNELL L. REV. 375, 392 (1974):

> If weightings on conflicting evidence need be only "reasonable" to pass the substantial evidence test, it follows that they can be less than reasonable and still survive the "arbitrary, capricious" test. If this is so, the latter standard subjects a rulemaker to only the most rudimentary command of rationality. In drawing empirical conclusions, he must give actual, good faith consideration to all relevant evidentiary factors. If he has in fact given serious attention to a factor, the weight which he assigns to it in his final judgments is of virtually no concern to the reviewing court.

the agency based its result on a sustainable rationale—i.e., that the agency demonstrated a logical connection between the evidence it adduced and the conclusion it reached.[98] In the words of *Overton Park*, § 706

> requires a finding that the *actual choice made* was not "arbitrary, capricious, an abuse of discretion, or otherwise not in accordance with law." To make this finding the court must consider *whether the decision was based on a consideration of relevant factors and whether there has been a clear error of judgment.* Although this inquiry into the facts is to be searching and careful, the ultimate standard of review is a narrow one. The court is not empowered to substitute its judgment for that of the agency.[99]

In recent years this court has elevated the *Overton Park* notion of *limited* substantive review of agency decisions in critical cases into a somewhat ill-defined doctrine commonly called the "hard look" doctrine of judicial review.[100] While the original concept, pioneered by the

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[98] *See, e.g., Communications Investment Corp.* v. *FCC*, 641 F.2d 954, 972 (D.C. Cir. 1980). In *Trans-Pacific Freight* v. *Federal Maritime Comm'n*, 650 F.2d 1235 (D.C. Cir. 1980), *cert. denied*, 451 U.S. 984 (1981), we summarized our narrow scope of review under the arbitrary and capricious standards as follows:

> After satisfying ourselves that the agency has acted within its statutory authority and that this action was accompanied by the appropriate procedural protections and was supported by sufficient evidence, we must inquire whether the rationale of the agency is both discernible and defensible. In undertaking this inquiry, we may not substitute our judgment for that of the Commission, but may only assure ourselves that the agency decision was rational and based on a consideration of the relevant factors.

Id. at 1251 (footnotes omitted).

[99] 401 U.S. at 416 (emphasis added).

[100] *See, e.g., National Lime Ass'n* v. *EPA*, 627 F.2d 416 (D.C. Cir. 1980); *Culpeper League for Envtl. Protection* v.

late Judge Leventhal, was that *agencies* should take a "hard look" at complicated technological decisions with serious environmental, health, and safety consequences,[101] later decisions have read the doctrine to require *courts* to take a hard look to ensure that agencies have taken a hard look.[102] Not surprisingly, the proper level and nature of *judicial*, as opposed to agency, scrutiny of informal rulemakings remains a subject of intense judicial [103] and scholarly [104] debate after *Vermont Yankee II*. Nevertheless, whether expressed in "hard look" terms or not, the limited substantive review endorsed by *Overton Park* addresses legitimate concerns. As Judge Wald recently noted in *National Lime Ass'n* v. *EPA*: [105]

> Collectively, these concerns have sometimes been expressed as a need for "reasoned decision-making"

NRC, 574 F.2d 633, 634 (D.C. Cir. 1978) (per curiam); *Greater Boston Television Corp.* v. *FCC*, 444 F.2d 841, 851, 859 (D.C. Cir. 1970), *cert. denied*, 403 U.S. 923 (1971); *Pikes Peak Broadcasting Co.* v. *FCC*, 422 F.2d 671, 682 (D.C. Cir.), *cert. denied*, 395 U.S. 979 (1969).

[101] *See, e.g., NRDC* v. *Morton*, 458 F.2d 827, 838 (D.C. Cir. 1972). *See also Kleppe* v. *Sierra Club*, 427 U.S. 390, 410 n.21 (1976). *See generally* Leventhal, *Environmental Decisionmaking and the Role of the Courts*, 122 U. PA. L. REV. 509 (1974).

[102] *See National Lime Ass'n* v. *EPA*, 627 F.2d 416, 451 n.126 (D.C. Cir. 1980) (describing evolution of this phenomenon).

[103] *Id.* at 451-54 (discussing cases).

[104] *See, e.g.*, Byse, *Scope of Judicial Review of Informal Rulemaking*, 33 AD. L. REV. 183 (1981); DeLong, *Informal Rulemaking and the Integration of Law and Policy*, 65 VA. L. REV. 257 (1979) [hereinafter DeLong]; McGowan, *Reflections on Rulemaking Review*, 53 TULANE L. REV. 681 (1979); Rodgers, *A Hard Look at Vermont Yankee: Environmental Law Under Close Scrutiny*, 67 GEO. L.J. 699, 704 (1979); Breyer, *Vermont Yankee and the Courts' Role in the Nuclear Energy Controversy*, 91 HARV. L. REV. 1833, 1834 (1978) [hereinafter Breyer].

[105] 627 F.2d 416 (D.C. Cir. 1980).

and sometimes as a need for adequate "methodology." However expressed, these more substantive concerns have been coupled with a requirement that assumptions be stated, that process be revealed, that the rejection of alternate theories or abandonment of alternate courses of action be explained and that the rationale for the ultimate decision be set forth in a manner which permits the public to exercise its statutory prerogative of comment and the courts to exercise their statutory responsibility upon review.[106]

D. The Standard of Review Applied to the Agency's Decision

1. *"Scope of Authority"*

As this court has held time and again,[107] the Atomic Energy Act's statutory delegation of authority to the NRC is unusually broad. Judge McGowan noted in *Siegel* v. *AEC*,

> [In the AEA] Congress . . . enact[ed] a regulatory scheme which is virtually unique in the degree to which broad responsibility is reposed in the administering agency, free of close prescription in its charter as to how it shall proceed in achieving the statutory objectives.[108]

The *Vermont Yankee II* Court was emphatic in its reaffirmation of the NRC's broad authority to deal with fuel cycle issues by rulemaking.[109] *Necessarily encompassed within that rulemaking authority is the power to*

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[106] *Id.* at 453 (footnotes omitted).

[107] *See, e.g., North Anna Envtl. Coalition* v. *NRC*, 533 F.2d 655, 662 (D.C. Cir. 1976); *Citizens for Safe Power, Inc.* v. *NRC*, 524 F.2d 1291 (D.C. Cir. 1975); *Union of Concerned Scientists* v. *AEC*, 499 F.2d 1069, 1079 (D.C. Cir. 1974); *Siegel* v. *AEC*, 400 F.2d 778, 783 (D.C. Cir. 1968).

[108] 400 F.2d 778, 783 (D.C. Cir. 1968).

[109] *See supra* p. 12 & note 30.

treat certain factual and policy issues generically.[110] And the power to treat those issues generically itself must include the discretion to incorporate a certain amount of prediction into the final rule's table of release values.[111]

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[110] Judge Bazelon expressly concedes this point, *see* Bazelon op. at 22, which Judge Tamm also specified in his *Vermont Yankee I* concurrence:

> [T]he decision to treat the waste storage issue through generic rulemaking because it is common to all licensing decisions is clearly a policy determination within the agency's special expertise which we should review only for clear abuse of discretion.

Vermont Yankee I concurrence at 661 n.11.

[111] Judge Leventhal stated this emphatically in *Minnesota* v. *NRC*, 602 F.2d 412 (D.C. Cir. 1979), *discussed in* note 63 *supra*:

> No one disputes that solutions to the commercial waste dilemma are not currently available. The critical issue is the likelihood (or probability) that solutions, either ultimate or interim, will be reached in time. . . . We agree with the Commission's position that it could properly consider the complex issue of nuclear waste disposal in a "generic" proceeding such as rulemaking, and then apply its determinations in subsequent adjudicatory proceedings. Where factual issues do not involve particularized situations, an agency may proceed by a comprehensive resolution of the questions rather than relitigating the question in each proceeding in which it is raised. Petitioners hypothesize the need for individualized determinations, but *we think it clear that the central issue posed by petitioners—the feasibility of interim or ultimate nuclear waste disposal solutions—is one essentially common to all nuclear facilities.*
>
> . . . We do not dictate the procedures of the "generic" proceeding. The breadth of the questions involved and *the fact that the ultimate determination can never rise above a prediction suggest that the determination [of the probability of finding a feasible solution] may be a kind*

The NRC has confidently—and to my mind, correctly—determined that the decision to promulgate a rule in the form of a noncomprehensive table of predicted release values—whose significance for human lives is subject to discussion in individual licensing proceedings, whose accuracy is subject to update and refinement, and whose uncertainties are candidly acknowledged—lies well within the authority granted to it by Congress. Under the Supreme Court's directive in *Power Reactor Development Co.* v. *International Union of Electrical, Radio, & Machine Workers*,[112] we are obliged to give that determination considerable deference.[113]

In accordance with *Power Reactor*, this court has frequently held that where agency rules, such as the one here, are based on "choices of policy, . . . assessment

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of legislative judgment for which rulemaking would suffice.

Id. at 416-17 (citations omitted) (emphasis added).

[112] 367 U.S. 396 (1961).

[113] In *Power Reactor*, the Commission interpreted its own licensing provisions to allow nuclear power plant construction permits to be granted based on a less complete finding of plant safety than would have been required to grant plant operating licenses. The Supreme Court deferred to the Commission's interpretation of its own statute, noting that

> nuclear reactors are fast-developing and fast-changing. What is up to date now may not, probably will not, be as acceptable tomorrow. Problems which seem insuperable now may be solved tomorrow, perhaps in the very process of construction itself. We see no reason why we should not accord the Commission's interpretation of its own regulation and governing statute that respect which is customarily given to a practical administrative construction of a disputed provision. Particularly is this respect due when the administrative practice at stake "involves a contemporaneous construction of a statute by the men charged with the responsibility of setting its machinery in motion, of making the parts work efficiently and smoothly while they are yet untried and new."

Id. at 408 (citations omitted).

of risks, or . . . predictions dealing with matters on the frontiers of knowledge" the agency has the authority to promulgate such rules, so long as they are based on such facts as are available and on rational predictions about how currently unanswerable questions will someday be answered.[114] Thus, an agency "may apply [its] expertise to draw conclusions from suspected, but not completely substantiated, relationships between facts, from trends among facts, from theoretical projections from imperfect data, from probative preliminary data not yet certifiable as 'fact,' and the like."[115] The agency does not merely have the power to promulgate a rule based on such predictions; it has a *duty* to do so as long as it exercises that

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[114] *Amoco Oil Co.* v. *EPA*, 501 F.2d 722, 741 (D.C. Cir. 1974). *Accord, Industrial Union Dep't* v. *Hodgson*, 499 F.2d 467, 474-75 & n. 18 (D.C. Cir. 1974).

Judge Mikva has recently pointed out that

> [t]he thoroughness and persuasiveness of the explanation we can expect from the agency will, of course, *vary with the nature of the prediction undertaken.* "Where existing methodology or research in a new area of regulation is deficient, the agency necessarily enjoys broad discretion to attempt to formulate a solution to the best of its ability on the basis of available information." *Industrial Union Dep't* v. *Hodgson*, 499 F.2d 467, 474 n.18 (D.C. Cir. 1974) . . . . At the other extreme, this court's inquiry into agency methodology in the physical sciences has been far more exacting "where the facts pertinent to [a] standard's feasibility are available and easily discoverable by conventional technical means." *National Lime Ass'n* v. *EPA*, 627 F.2d 416, 454 (D.C. Cir. 1980).

NRDC v. *EPA*, 655 F.2d 318, 326 (D.C. Cir. 1981) (emphasis added). There can be little doubt that the agency prediction here—that a long-term solution to the waste disposal problem will be found—lies within the area where existing research is deficient and the agency necessarily enjoys broad discretion.

[115] *Ethyl Corp.* v. *EPA*, 541 F.2d 1, 28 (D.C. Cir.) (en banc), *cert. denied*, 426 U.S. 941 (1976). *See also EDF* v. *EPA*, 598 F.2d 62, 83-85 (D.C. Cir. 1978).

authority "subject to the restraints of reasonableness, and does not open the door to '"crystall ball" inquiry.'" [116]

Judge Bazelon does not openly challenge the broad powers exercised generally by the NRC under the authority of the AEA, but he does not expressly recognize them, either. And it is obvious that the deference due to the Commission has not tempered the majority's determination to find some error in the Table S-3 Rule. Here, as in *Vermont Yankee I*, it is a NEPA-based standard of Judge Bazelon's manufacture, bootstrapped into the APA, which provides the means to the "desired" end. Contrary to holdings in this court recognizing the flexibility of agency duties under NEPA in the face of uncertainties,[117] the majority has found in its construction of NEPA *procedural* and *substantive* standards by which to limit the NRC's broad substantive discretion. It holds that the Commission's action failed to meet NEPA's mandates and that it was taken without proper consideration of all relevant factors. These relate more to *Overton Park's* second and third inquiries than to the general question of authority.

2. *"Observance of Procedure"*

The *Vermont Yankee II* Court confirmed our duty to conduct a limited procedural review of the Commission's activity by restating the second aspect of the *Overton Park* analysis: "Of course, the [circuit] court [on remand] must determine whether the agency complied with the *procedures* mandated by the relevant statutes." [118] It warned, however, that we "should . . . not stray beyond the judicial province to explore the procedural format or to impose upon the agency its own notion of which proce-

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[116] *International Harvester Co.* v. *Ruckelshaus*, 478 F.2d 615, 629 (D.C. Cir. 1973). *Accord, NRDC* v. *EPA*, 655 F.2d 318, 328-29 (D.C. Cir. 1981).

[117] *See supra* pp. 17-18.

[118] *Vermont Yankee II* at 549 n.21.

dures are 'best' or most likely to further some vague, undefined public good." [119] Judge Bazelon has effectively ignored this warning, however, and once again disguises a strict substantive review under NEPA in a fundamentally procedural rubric. While our scrutiny for compliance with NEPA's procedural mandate may be, as Judge Bazelon asserts, a close one, it must not extend across the line separating the Commission's procedural duty from substantive determinations and policymaking. The latter category of action is properly reviewable only under the "arbitrary and capricious" standard. Thus, although I agree with the majority opinion that NEPA's requirements are among those providing an overall procedural standard for the Commission's action, I disagree with Judge Bazelon's assertions of what those requirements are and how they are to be applied in the rulemaking context.

The Supreme Court emphasized in *Vermont Yankee II* that while "NEPA does set forth significant goals for the Nation, . . . its mandate to the agencies is essentially procedural," [120] and that "the only procedural requirements imposed by NEPA are those stated in the plain language of the Act." [121] The plain language of NEPA, to the extent relied upon by the majority,[122] requires simply that a detailed statement of environmental impacts, effects, and irretrievable resource commitments, as well as alternatives to the proposed activity, be included

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[119] *Id.* at 549. That the Commission satisfied the procedural requirements for informal rulemaking under the APA was virtually dictated to us at that time: "[T]here is little doubt that the agency was in full compliance with all the applicable requirements of the Administrative Procedure Act." *Id.* at 549 n.21.

[120] *Vermont Yankee II* at 558.

[121] *Id.* at 548.

[122] *See* Bazelon op. at 30.

in recommendations for "major Federal actions." [123] And while this "detailed statement" is only "the outward sign that the environmental values and consequences have been considered during the planning stage of agency actions," [124] the Act does not prescribe exactly *how* this consideration must be made. Thus, any NEPA-based review consistent with *Vermont Yankee II* must be limited to a scrutiny of compliance with only the "outward signs" of environmental consideration clearly prescribed by the Act.[125]

Notwithstanding the Supreme Court's clear guidelines, however, Judge Bazelon has again strayed beyond judicial province to register his dissatisfaction with the methodology underlying the Table S-3 Rule and to prescribe "procedural" mandates which, however promotive of an ideal that environmental concerns play a vital role in government decisionmaking, simply are not among those required by Congress under NEPA.[126]

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[123] 42 U.S.C. § 4432(2)(C) (1976).

[124] *Andrus* v. *Sierra Club*, 442 U.S. 347, 350 (1979).

[125] Even a close scrutiny for compliance with the procedural details is tempered by a "rule of reason"—a recognition that a court can require no more than a discussion of reasonably foreseeable impacts and reasonable alternatives. *See NRDC* v. *Morton*, 458 F.2d 827, 834 (D.C. Cir. 1972).

[126] The error in Judge Bazelon's approach on remand is thus the same (albeit in a slightly different form) as that identified by the Supreme Court in its review of *Vermont Yankee I*. This court originally held that the rulemaking procedures provided by the Commission were inadequate because they were not designed to ventilate the environmental issues to the majority's satisfaction, or to afford the best possible consideration to environmental impacts. It therefore saw fit to dictate that agencies "develop new procedures to accomplish the innovative task of implementing NEPA through rulemaking." *Vermont Yankee I* at 653. This much of the *Vermont Yankee I* decision was unanimously reversed by the Supreme Court, which held that a court must not use NEPA to assign proce-

The majority's first novelty is the elevation of "uncertanties" to the level of separate environmental impacts, effects, or costs. Although this is no easy task in logic, since uncertainty is a *quality* inherent in all impacts as well as benefits, of which there is less than complete certitude, the equation is accomplished semantically with apparent ease. Pointing to "1) uncertainty concerning the integrity of the [projected] permanent repository . . . and 2) uncertainty over whether and when such a repository . . . will be built," [127] he concludes that "these uncertainties *reflect* two environmental costs of licensing a plant." [128] From that point "costs" are treated as an equivalent to "uncertainties," and uncertainties thus become costs which must be considered under NEPA.

Judge Bazelon's prescription does not end there, however. Under his analysis no simple consideration of costs will do: "Although the Commission did consider these uncertainties, it did not do so *in a manner that would allow* licensing decisions to be affected." [129] The majority's bottom line is that uncertainties may be *fully considered* only if openly *balanced* against benefits, as costs now traditionally are. This, it is maintained, is the type of

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dure to a rulemaking which is both beyond that prescribed by the APA *and not clearly required by NEPA*. The court stated,

> Absent constitutional constraints or extremely compelling circumstances the "administrative agencies 'should be free to fashion their own rules of procedure and to pursue methods of inquiry capable of permitting them to discharge their multitudinous duties.'" *FCC* v. *Schreiber*, 381 U.S., at 290, quoting from *FCC* v. *Pottsville Broadcasting Co.*, 309 U.S., at 143. Indeed, our cases could hardly be more explicit in this regard.

Vermont Yankee II at 543-44.

[127] Bazelon op. at 45.

[128] *Id.* (emphasis added).

[129] *Id.* at 46 (emphasis added).

consideration described in *Calvert Cliffs'*;[130] and thus, we are led to conclude, is the type of consideration *required* by NEPA in this case. And because the Commission "did not rule that the [uncertainties] were insignificant, [or] rule that they were outweighed by generic benefits that would also be excluded from the licensing boards' consideration,"[131] and because the promulgation of a rule calling for an assumption that post-sealing repository releases would be zero *prevented* licensing boards from considering uncertainties in their own balancing,[132] "the Commission directly contravened NEPA's requirement that environmental costs be considered 'at every stage where an overall balancing of environmental and non-environmental factors is appropriate.'"[133]

Thus, in a series of small steps, Judge Bazelon has held that uncertainties in the assumptions underlying the figures in the fuel cycle rule can be considered, consistent with NEPA, only as separate environmental costs, balanced in common EIS practice against benefits. He has severely qualified and limited the Commission's authority to determine by an otherwise reasonable generic process that certain factors do not merit separate consideration in individual licensing proceedings.[134] Clearly, the re-

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[130] *Id.* at 44. *See also* note 17 *supra.*

[131] *Id.* at 46.

[132] *Id.* at 45.

[133] *Id.* at 46, quoting *Calvert Cliffs'*.

[134] The majority has simply couched in procedural review a disagreement with reasoned policy decisions by the Commission. Among those, made only after reasoned consideration of uncertainties, was its determination that the effect of uncertainties on the selection of fuel cycle impacts was a generic question properly dealt with "*as part of* choosing what impact values should go into the fuel cycle rule." Final Rule Statement of Basis and Purpose at 45,369. A related conclusion was that, since uncertainties had been considered as part of selecting the rule's impact values, they need not be reflected

quirements described by Judge Bazelon are not among the procedural requirements "stated in the plain language of [NEPA];" [135] they are "creature[s] of judicial cloth, not legislative cloth," [136] and are an improper basis for invalidating the Rule. Our critical review of an agency's action, such as the S-3 Table here under scrutiny, ends with a determination that the decisionmakers have satisfied the key "procedural" requirement of considering environmental consequences of and alternatives to the proposed action. Even though NEPA provides that environmental considerations must be made "to the greatest extent possible," we may not, under the guise of close scrutiny for procedural compliance, dictate to the agencies just *how* this consideration is best made. As each of the four major Supreme Court NEPA cases [137] has shown, judicial review of agency compliance with NEPA is to be tempered by a recognition that full compliance is measured against the agency's structuring of its own proceedings, in which the agency is to be accorded the greatest deference.

3. *"Reasoned Decisionmaking"*

I agree with Judge Bazelon's statement that "a reviewing court must set aside an agency finding as arbitrary if it determines that the finding is not based upon consideration of relevant factors or if it is based on a clear

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explicitly in the fuel cycle rule. These are not rulings on procedural infirmities but are by their nature *substantive holdings*, the result of a review process at odds with the limits of our scrutiny under the APA. *See* section III.D.3. *infra*.

[135] *See supra* p. 43.

[136] *See Weinberger* v. *Catholic Action of Hawaii/Peace Educ. Project*, 50 U.S.L.W. 4027, 4028 (1 Dec. 1981).

[137] *Vermont Yankee II; Kleppe* v. *Sierra Club*, 427 U.S. 390 (1976); *Flint Ridge Development Co.* v. *Scenic Rivers Ass'n*, 426 U.S. 776 (1976); *Aberdeen & Rockfish* v. *SCRAP Comm.*, 442 U.S. 289 (1975).

error of judgment." I strongly disagree, however, that this rule, properly applied to this case, should yield the result reached by the majority.

Although the fact is not specifically acknowledged, it is obvious from a careful examination of Judge Bazelon's opinion that the majority's holding against the Table S-3 Rule is rooted simply in its dissatisfaction with a single conclusion underlying the Rule: that licensing boards effectively may ignore the uncertainties inherent in any projections related to long-term storage of nuclear wastes in favor of the probability-based zero-release figure. Judge Bazelon concedes that "uncertainties can be assessed generically, and that attendant risks can be assessed generically," [138] but states categorically that "the Commission cannot find the environmental cost represented by the uncertainties to be zero unless their cost is, in fact, zero." [139] He has obviously made from the zero-release figure included in the Rule something which it is not—a finding of fact rather than simply a practical estimate for limited purposes. A careful review of the Commission's contemporaneous explanations convinces me that there is no basis for finding this determination by the NRC to be arbitrary, capricious, or clearly erroneous; nor is it "otherwise not in accordance with law," as the majority suggests. The majority has simply substituted its "expertise" for that of the Commission.

The relevant question with regard to the zero-release assumption is not whether the zero figure itself is precisely accurate but whether the Commission's decision to adopt it was reasoned. The first step must be to recognize that the figure was never meant to be a "factual finding," as the majority proposes; [140] it is intended only as a generic determination of the *appropriate weight* to

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[138] Bazelon op. at 47.

[139] *Id.*

[140] *Id.* at 36-42.

be accorded in licensing proceedings to risks of radioactive emission from long-term waste storage. The Commission did not decide that releases would *never* occur at the projected federal repository. It only decided, in view of the staff's assumption that fission-product gases would be released prior to sealing and its finding of extremely low probability of repository failure, that "taking post-sealing releases as zero does not significantly reduce the overall conservatism of the table." [141]

As noted earlier, the majority concedes that "the Commission's zero-release assumption is probably characterized better as a decisionmaking device, . . . instructing licensing boards to assume that nuclear waste will have no impact on the environment once it is sealed in a repository, [and] allocat[ing] to the Commission sole responsibility for considering the risk that long-lived wastes will not be disposed of so successfully." [142] Yet rather than to afford the Commission any deference in its decision to include the zero figure "device" in the generic rule, Judge Bazelon has cut to the quick of the NRC's expertise and judgment: "For an agency to go forward in the face of significant uncertainty and issue such a rule indicates either a failure to consider a relevant factor or a clear error in judgment, . . . [and] that is precisely what the Commission did in promulgating the Table S-3 Rule." [143] The record clearly contradicts this conclusion.

There is no question that the Commission considered relevant factors—including the uncertainties with which Judge Bazelon is so concerned—in deciding to promulgate the S-3 Rule. The record is replete with evidence that the Commission took fair account of these uncertainties. Judge Bazelon in fact observes that "[f]rom the time it proposed the original Rule . . . through its promulgation

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[141] Final Rule Statement of Basis and Purposes at 45,369.

[142] Bazelon op. at 42.

[143] Bazelon op. at 49.

of the final Rule, the Commission *became increasingly candid in its acknowledgment of uncertainties underlying permanent waste disposal.*" [144] We can demand no more, and the majority's holding that relevant factors were not "properly considered" because the consideration did not take a particular form or yield a "usable" result [145] exceeds the limits of our judicial prerogative in a substantive review of agency decisions under the APA.[146]

The Commission's decision not to reflect uncertainties about long-term waste storage directly in the table was simply part of its overall decision to treat an issue generically. That decision was a quintessential *policy judgment.*[147] The Commission chose to incorpo-

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[144] *Id.* at 41 n.118 (emphasis added).

[145] *See id.* at 48.

[146] As this court observed in *North Slope Borough* v. *Andrus*, 642 F.2d 589 (D.C. Cir. 1980),

> Given a "fully informed" and "well-considered" decision, an agency decision is entitled to judicial deference; in other words, an informed and deliberate agency decisionmaker is entitled to be arguably "wrong," a court's differing view of wisdom in administration notwithstanding. Obedience to NEPA is a matter of the administrative agency acquiring and digesting useful information about the environmental ramifications of major federal projects.

Id. at 599.

[147] As such, the decision hardly seems in violation of NEPA. As one commentator has noted:

> Decisions based on extreme uncertainty are quintessential policy judgments. Although the nature and degree of risk underlying an official endorsement of continued nuclear waste generation may be highly contested issues, *the correctness of the official position is not assailable in the courts on policy grounds.* NEPA sets no standards for factual predicate sufficiency. *If the full scope of uncertainty is exposed and duly considered, the NEPA mandate is satisfied.* Dissatisfied rulemaking participants may enlist the aid of the courts if they can prove

rate into the table only those values to which it could reasonably assign a figure. It did not attempt to quantify the uncertainties surrounding the figures themselves because they were inherently unquantifiable.[148] It did not require individual licensing boards to weigh repeatedly the effects of uncertainties because it was aware that individual boards were incapable of doing a better job of analysis than the Commission had already done. It did not institute a separate generic proceeding to consider uncertainties because the Commission expected that long-term effects would be more fully analyzed and understood after the concurrent "waste confidence" proceeding had concluded. In view of all of these considerations, I do not believe the Commission abused its discretion by finding "no advantage in having licensing boards repeatedly weigh" for themselves the unquantifiable uncertainties inherent in the rule it adopted—a table whose values mixed both fact and prediction.

Nor did the Commission fail to take a hard look at the whole problem before it. Its avowed objective was to produce a conservative, noncomprehensive table of model fuel cycle impacts; its methodology was directed toward that objective. Its working assumptions were revealed, alternative theories exposed and

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that agency officials are being disingenuous about the unknowns involved, but they must turn to avenues of political redress if they simply disagree that the full data base is sufficient to predict a negligible environmental impact.

Comment, *Implementing the National Environmental Policy Act through Rulemaking*, 126 U. PA. L. REV. 148, 190 (1977) (emphasis added).

[148] *Cf. Union of Concerned Scientists* v. *AEC*, 499 F.2d 1069, 1093 (D.C. Cir. 1974) ("Considering the unpredictable nature of some of the factors [before the Commission] . . . it would actually be surprising if it had attempted to incorporate the probability of their occurrence into its estimate of environmental impact.")

explained, and its ultimate rationale set forth in a logical and comprehensible manner. The Commission's decision not to search out and eliminate *all* uncertainties from its table can hardly be characterized as irrational in view of the limited purpose for which that table was being created.

There was no clear error in the Commission's conclusion that the use of a zero-release figure, rather than one which reflected a post-sealing release probability which was zero to many decimal places, would have little effect on an individual board's decision to license any given plant.[149] Even after considering the uncertainties involved in its projections of long-term waste storage techniques, the NRC concluded that the probabilities (of which uncertainty is itself an element) still favored the assumptions made and that the presence of uncertainties required no modification of the judgmental zero-release figures. This conclusion did not foreclose further investigation into or consideration of the uncertainties, and it did not preclude the licensing boards from considering uncertainties which were not separately considered in the Commission's generic determination. It was not a conclusion which was outside the realm of reasonableness. A fortiori, I cannot find the Commission's decision to adopt the *entire table*, of which the zero-release figure

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[149] This court has long recognized that when an agency's environmental impact statement

> involves educated predictions rather than certainties, it is entirely proper, and necessary, to consider the probabilities as well as the consequences of certain occurrences in ascertaining their environmental impact. *There is a point at which the probability of an occurrence may be so low as to render it almost totally unworthy of consideration.*

Carolina Envtl. Study Group v. *AEC*, 510 F.2d 796, 799 (D.C. Cir. 1975) (emphasis added).

was but one small part, arbitrary, and capricious, given the compensating conservatism of the rest of the table.[150]

Nor can I say, in light of recent precedent, that the NRC has shirked its substantive obligations under NEPA. After *Strycker's Bay Neighborhood Council*, our only role "is to insure that the agency has considered environmental consequences."[151] Here the Commission satisfied its obligation to consider those consequences in two ways: by considering whether the assumption of complete repository integrity (inherent uncertainties and all) would disrupt the overall conservatism of Table S-3 and skew subsequent environmental cost-benefit analyses; and by permitting the *significance* to the environment of the chosen fuel cycle impact values to be the subject of discussion at individual licensing proceedings.

I cannot avoid contrasting Judge Bazelon's surprisingly stringent review of the Commission's conclusions

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[150] Indeed, two Commissioners who expressed concern about the zero release figure concurred in the final statement of basis and purpose for just the reasons I have given. Commissioner Bradford concurred in the table "with the understanding that it is to be extensively supplemented" by the explanatory narrative and the update proceedings, and concurred in the zero-release figure because it appeared "better founded than the same figure in the present interim version and because, as the Commission states, *this assumption does not appear to affect the S-3 table's overall conservatism.*" Final Rule Statement of Basis and Purpose at 45,372 (Separate Views of Commissioner Bradford on S-3) (emphasis added). Commissioner Gilinsky, also stating his views separately, expressed similar concern about the zero figure, but noted that the forthcoming "waste confidence" proceeding was the "appropriate vehicle for a thoroughgoing evaluation of the problems involved in the government's commitment to a waste disposal solution and the likelihood that such a program is not only feasible but is also on course." *Id.* at 45,374 (Separate Views of Commissioner Gilinsky on Final Adoption of S-3 Rule).

[151] *See supra* p. 14.

concerning the technological feasibility of the assumptions underlying the values in Table S-3 with his deferential, straightforward, and proper application of the arbitrary and capricious test to the NRC's conclusions of economic feasibility. He concedes that standards guiding conclusions concerning economic feasibility "may be based on realistic, conservative, and reasoned forecasts," [152] yet the forecasts upon which the Commission based its conclusions of technological feasibility were no less "realistic, conservative, and reasoned." And he is willing to look to the record as a whole for evidence that the NRC considered factors relevant to dollar cost and that it "reached a conclusion that is within the range of reasonability," [153] yet is unwilling to afford the same deference to the Commission's consideration of the uncertainties relevant to its technological predictions.

I am puzzled only by Judge Bazelon's decision not to apply the standard which tempered his substantive review of the NRC's economic conclusions to the case as a whole.[154] If in the economic arena, then a fortiori in the technological arena, the court must accord to the Commission the deference due in this case.

Based on this review of the authority upon which the NRC acted in this informal rulemaking, the procedures it employed, and the stated rationale for its decision, I believe we have ample ground to affirm.

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[152] Bazelon op. at 63.

[153] *Id.* at 68.

[154] The Commission's working assumption that safe waste-disposal methods are technologically feasible is no less reasoned than its assumption that economic resources will be available to meet disposal needs. There is no justification for labeling either conclusion arbitrary or capricious in this case. Both involve a mixture of factual and policy judgments, many of which the Commission is in the best position to make.

IV. Living With Uncertainty

Having expressed my concerns with the particulars of Judge Bazelon's analysis, I am compelled to respond specifically to the central, and equally harmful *implication* of the majority's opinion. Whether his holding is based outwardly on procedural or substantive grounds, the effect of the majority's analysis is to state that it is error for the Commission *to proceed in the face of admitted uncertainties.*

In our everyday lives we make countless minor and major decisions, hopefully without stepping beyond the bounds of reason, despite unfathomable uncertainties. We drive our cars without understanding fully the potential risk of injury and death; we eat, drink, and breathe without total certainty that the substances we ingest will not cause long-term disease; we plan for our futures without assurance that that future will not be obliterated by unexpected wars, plagues, or natural disasters. Of course we try to evaluate the risks of automobile accident, fatal disease, and possible calamity as well as we can. But when those risks are truly incalculable, and potential outcomes are truly *uncertain*, we necessarily face a decision: do we stop until all uncertainties are resolved, or do we proceed cautiously in the face of uncertainty, making tentative assumptions and predictions, and revising and perfecting those predictions as more information becomes available?

In the nuclear power area it is Congress which has made the decision to proceed in the face of uncertainties.[155] Congress has charged the NRC not only with

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[155] *See supra* pp. 18-19.

See also Judge Edwards' concurring opinion, which admits that

> [i]t is not the function of the judicial branch either to initiate or to halt the development of a nuclear power

authority and discretion to decide how best to proceed, but also with a mandate to predict likely future developments.[156] As a reviewing court we are entitled to demand that the Commission's predictions be based on logic and the best available information; we may further demand that the Commission seek out new information as it becomes available, and that it continually modify its rules to reflect the state of existing knowledge.[157] A *reviewing court* exceeds its authority, however, when by the stringency of its review it effectively forces an agency to employ new procedures or to rewrite its rules until it reaches what the court believes is the best or correct result.[158]

> industr[illegible] These national policy choices are constitutionally ve[illegible]n the President and the Congress of the United States, and they have been made in favor of proceeding.

Edwards' op. at 2.

[156] *Cf. NRDC* v. *EPA*, 655 F.2d 318, 334-36 (D.C. Cir. 1981) (discussing agency's duty to predict).

[157] In *Geller* v. *FCC*, 610 F.2d 973 (D.C. Cir. 1979), we held that the FCC was required to reconsider rules issued in 1972 because the factual predicate upon which the regulations had been based had changed. Similarly, in *United Steelworkers of America* v. *Marshall*, 647 F.2d 1189, D.C. Cir. 1980), we applied similar reasoning to the question whether an agency had discretion not to implement new standards if standards originally thought "feasible" turned out not to be so:

> [W]here employers believe that a standard originally determined to be feasible has proved infeasible, they could petition the agency to initiate a new rulemaking to review the standard. . . . [*W*]*here time does demonstrate the infeasibility of a standard once approved as feasible, so that the very predicate for the original rule and its statutory basis have disappeared, a court may well be able to deny the agency any discretion to refuse a new rulemaking.*

Id. at 1273 (emphasis added).

[158] *See Vermont Yankee II* at 546.

Judge Bazelon's opinion today invites this court to exceed the scope of its authority in just this manner. By holding that generic uncertainties must be treated as separate environmental impacts which, unless *explicitly* factored into a generic rule,[159] must be considered anew in each individual proceeding, Judge Bazelon is dictating to the Commission when and where, and under what conditions, it must consider a policy question Congress has empowered it to decide. Yet, after *Vermont Yankee II*, courts must candidly acknowledge that the choice of when, where, and under what conditions the regulatory agency makes such policy determinations lies within the agency's discretion, especially when uncertainty is rife and technology is fast-developing.

It is not clear just how the invalidation of the S-3 Rule and the remand ordered in this case will help the NRC to make a better decision than it has already made. Whenever toxic materials are placed in a container, a risk is created that human lives will be endangered. The magnitude of that risk, however, depends on a variety of factors, including the amount and toxicity of the materials being isolated, the duration of their isolation, and the long-term integrity of their container. A comprehensive assessment of the likelihood of injury to human life from waste repository releases would require examination and evaluation of almost an infinite and at this time incalculable number of variables.[160]

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[159] *See, e.g.*, Bazelon op. at 47.

[160] As one recent analysis of nuclear power decisionmaking has noted,

> An appreciation of the associated hazards [of long-term nuclear waste disposal] requires an understanding of the long-term integrity of the geologic environment into which wastes are placed, the seismic integrity of rock formations, the rates of exchange between ions in ground water and in dissolved wastes, and the transport rates of water through the ground. Moreover, the waste mate-

Judges Bazelon and Edwards have effectively imposed upon the NRC and its licensing boards an impossible task of predicting this court's response to their activities. The agency cannot be sure that another aspect of its rule or procedure will not be discredited in a future appeal unless it hunts down every factor it can think of and attempts somehow to qualify and evaluate its uncertainties as "environmental costs," an equivalence which has not been thought to exist before. It goes without saying that such an effort would require an enormous commitment of agency time and resources. The only certainty achievable by this process—and it *will* be achieved—is *delay* in the development of nuclear power.

More significantly, even if the NRC chose to devote *all* of its time and staff to studying the risk to human life of long-term waste storage—at best a questionable allocation of agency resources [161]—it still could not root out all

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rials have toxicities ranging from negligible to lethal in microscopic quantities, and there is controversy over the dose-mortality relationships involved. There also exist unanswered questions of rock mechanics, large-scale hydrology, and uptake of toxic metals by vegetation.

Yellin, *High Technology and the Courts: Nuclear Power and the Need for Institutional Reform*, 94 HARV. L. REV. 489, 533-34 (1981) [hereinafter Yellin].

[161] Professor Yellin's penetrating study of judicial review of nuclear power decisionmaking extensively surveys existing scientific studies on long-term waste disposal and concludes that that problem should rank relatively low on the list of NRC environmental concerns:

> The NRC is justified in concluding that the disposal of nuclear wastes is not intrinsically a major concern. Permanent geologic disposal of wastes can create widespread contamination of ground water and soil, but at very low levels of radioactivity. On emplacing wastes hundreds of meters or more below ground, the earth itself becomes a substantial barrier to contamination of the biosphere, effective for centuries or more. . . . [A]ssuming reasonable efforts are made to choose a site isolated from ground

uncertainties.[162] Even if it managed by further research to place boundary values on those uncertainties, and thus succeeded in producing a "risk value," [163] of some sort, the NRC still would have accomplished only half of its statutory task. *At some point the agency would still have to decide whether or not that level of risk and uncertainty was an acceptable one.*[164]

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water in a suitable medium, with waste dispersed in a geometric configuration that in itself will guard against water intrusion and ground diffusion, the dominant risks are associated with migration over millenia of heavy isotopes, principally plutonium-239, and of a few fission products, such as iodine-129 and technetium-99. *While it is conceivable that these materials will cause low-level, widespread ground and water contamination, no major risk to individuals is foreseeable.*

Id. at 541 n.317 (citations omitted) (emphasis added).

[162] The words of the Research Director of the Administrative Conference of the United States seem particularly apt here:

> Anyone confronted with uncertainty naturally tends to hope that another study or consideration of an additional set of factors will resolve the issues. *Information is not costless, however, and an administrator allocating a budget has to focus on the value of the information versus the costs of collection.* A court has no practical incentive to weigh such costs in deciding whether an agency should have investigated more thoroughly and as a result *courts might tend to demand the collection of information even when the decision at issue is not sensitive to the additional information.*

DeLong, *supra* note 104, at 310 (emphasis added).

[163] Risk values are never exact numbers, but rather imprecise representations of a *range* of hazards considered probable. Agencies usually compute levels of risk by assuming a conservative set of assumptions, then setting boundary levels of risk which establish the range of probabilities for a particular type of event. *Id.* at 346-47.

[164] [I]n most cases [where a policymaker is stuck with a choice] the relevant datum for the decision is precisely the fact that the matter is uncertain. In other words, he

There can be no doubt that the decision whether to stop or proceed in face of a certain level of risk and uncertainty is a policy choice clearly within the agency's discretion. Yet the majority's opinion today amounts to nothing more clearly than a judicial proclamation that the current level of risk-assumption is unacceptable. As then-Professor (now Judge) Breyer pointed out with respect to Judge Bazelon's *Vermont Yankee I* opinion, however, this kind of risk-acceptability determination disguised as "hard look" judicial review "allow[s] courts to play too prominent a role in determining how the United States will produce energy in the future." [165] Were courts

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must confront the uncertainty rather than convert it into a fictional certainty. The crucial questions are how to narrow the uncertainty and decide the proper course under conditions of uncertainty, given the consequences of error.

. . . The issue for the court is whether the agency structured its decision to highlight uncertainty problems and deal with them rationally.

Id. In this case, the Commission expressly chose to accept the "risk of uncertainty" at the generic rulemaking stage. *See* text and accompanying note 68 *supra*. The only question before us is whether that decision was an abuse of discretion. *See* note 147 *supra*.

[165] [I]t is reasonable to conclude that court-imposed delays in the process of nuclear plant approval are not "neutral." They affect the decisionmaking process, tending to move the decisions of those who actually build power plants in the direction of coal, which may well prove more hazardous and environmentally destructive than nuclear plants. In these circumstances it is wrong for the courts to impose a *specially* stringent standard of review that requires regulatory agencies to take a *specially* "hard look" at all relevant factors before approving nuclear power plants. This would allow the courts to play too prominent a role in determining how the United States will produce its energy in the future.

Breyer, *supra* note 104, at 1840 (emphasis in original).

One commenting physicist has noted that notwithstanding that the environmental effects of wastes from coal-burning

to apply Judge Bazelon's unusually stringent standard of review to other NRC rulemakings, alternative energy sources—whose production is not so carefully regulated and whose long-term environmental effects are even less well-known—will become artificially attractive to the public utilities who must choose the most economical, reliable, and accessible of the available sources of energy generation.[166] Furthermore, if judges myopically focus on the risks and uncertainties peculiar to *any* particular type of energy, they will likely create another, equally real and equally problematic type of uncertainty—namely, uncertainty about regulatory delay which destroys the regulated firms' incentive to innovate.[167]

At oral argument in this case, counsel for the petitioners assailed the Commission for failing to reflect in its rule one particular type of risk—the risk of repository leakage resulting from random drilling. According to probabilities, counsel argued, such drilling could cause a repository leak once every 2,500 years—in retroactive perspective, once from now to before the Battle of Marathon. Given that some have projected the expected life of a long-term waste repository as 250,000 years, counsel con-

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plants remain largely unquantified, the sulphur oxides from a single plant [emitted at a rate of about 10 pounds per second], are estimated to cause about 25 fatalities and 60,000 cases of respiratory disease . . . [and] about $25 million in property damage annually." Cohen, *High Level Radioactive Waste*, 21 NAT. RESOURCES J. 703, 703 (1981). By comparison, "[e]stimates show that radioactive emissions from a nuclear plant may cause about one fatality every 50 years." *Id.* at 704.

[166] *See* Breyer, *supra* note 104, at 1845.

[167] The impact of regulatory uncertainty on the incentive of public utilities to innovate has been well-chronicled. *See, e.g.*, Cohen, *Innovation and Atomic Energy: Nuclear Power Regulation, 1966-Percent*, 43 LAW & CONTEMP. PROBS. 67 (1979) (time, expense, and uncertainty in acquiring NRC licenses are key factors inhibiting innovation); Braeutigam, *The Effect of Uncertainty in Regulatory Delay on the Rate of Innovation*, 43 LAW & CONTEMP. PROBS. 98 (1979).

tended that the Commission had ignored a "substantial risk." [168]

Lord Rothschild, a former director of the British Advisory Council for Science and Technology, has made a telling point about such "apparently authoritative utterance[s]" about "substantial risks":

> There is no such thing as a risk-free society. . . . But there is no point in getting into a panic about the risks of life until you have *compared* the risks which worry you with those that don't—but perhaps should. Comparisons, far from being odious, are the best antidote to panic.[169]

Even assuming the worst—that counsel is perfectly correct [170] and that a repository failure caused by random drilling would in fact cost thousands and thousands of

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[168] I must assume that this particular risk is one which Judge Bazelon would include among those reflected in his "uncertainty concerning the integrity of the permanent repository." *See* Bazelon op. at 45.

[169] *Rothschild, Coming to Grips with Risk*, Wall St. J. (13 Mar. 1979) at 22, col. 4 (emphasis in original) [hereinafter Rothschild].

[170] Professor Yellin points out the *deceptiveness* of citing 250,000 years—ten times the half-life of plutonium-239—as the appropriate figure for measuring repository life. By citing the same figure in *Vermont Yankee I*, Professor Yellin suggested, this

> court responded to perhaps the public's deepest anxieties concerning nuclear energy, failing to realize that a defensible index of the hazards of radioactive waste does not follow simply from the long half-lives of some of the more toxic waste constituents, but from a complex of considerations such as the repository design, the biologic effects of remnant radioactive species, and possible modes of releasing the wastes into the biosphere.

Yellin, *supra* note 160, at 538-39.

I would further suggest the *irrelevancy* of worrying 250,000 years into the future. I, for one, find it difficult to plan that far ahead.

lives [171]—before we decide to panic we should *compare* the risks described by counsel with some of the risks we normally confront, and accept, in our everyday lives.

In effect, petitioners' counsel urges us to postpone *all* nuclear power plant construction because the Commission has adopted a rule which removes from individual licensing proceedings the consideration of *a risk substantially less than the risk that he would die on a given day from a*

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[171] In fact, a careful summary of the available scientific data suggests that this would not be the case:

> Unlike major reactor accidents, . . . release of wastes from a mined repository cannot cause catastrophic events threatening public health. At worst, it can lead to widespread contamination of groundwater and soil at very low levels of radioactivity.

Id. at 534-35.

Professor Cohen notes that, even if ground water were contaminated at the projected depths of a repository,

> ground water moves quite slowly, typically only inches per day, . . . [and] ordinarily travels many miles before reaching the surface from 2,000 feet underground. Hence, even if dissolved radioactive material moved with the ground water, it would take about 1,000 years to reach the surface . Additionally, processes which constantly filter the radioactive materials out of the ground water cause the material to migrate about a thousand times slower than the water itself. Thus, it would take most of the radioactive material about a million years to reach the surface even if it were already dissolved in ground water. Moreover, most of the radioactive materials are highly insoluble under most geological conditions. If the materials were in solution when the water encountered normal conditions (chemically reducing, alkaline), they would precipitate out and form new rock material.
>
> Finally, if radioactivity did reach surface waters it would very easily be detected. One millionth of the amounts that can be harmful are readily detected. Measures could be taken to prevent the waste from getting into drinking water or food.

Cohen, *supra* note 165 at 714-15.

volcanic eruption[172] *or from common influenza!*[173] I think it safe to say that such risks have never stopped petitioners' counsel from making either short-term or long-term plans in his everyday life. Indeed, he would probably deny that he had even failed to "consider" those risks; instead, he would probably assert that he had considered and dismissed them, just as we daily dismiss the countless possible, yet unpredictable, risks and uncertainties which fill our daily lives. I find it highly anomalous that counsel so fervently argues that far smaller risks should prove not merely significant, but dispositive, in an area so multifaceted and complex as the NRC's regulation of the licensing of a light water power reactor.

V. Conclusion

A close examination of the majority's opinion today reveals that it has taken no more than a giant step sideways from an analysis rejected unanimously by the Supreme Court in *Vermont Yankee II*. It matters little that Judge Bazelon's latest approach has taken on a slightly different form or is presented under a different banner than his analysis in *Vermont Yankee I*. Its focus and effect are unchanged. *Vermont Yankee III* does not cure the first-round defects of *Vermont Yankee I*; it compounds them.

Simply put, the majority has created a new standard by which to gauge agency rulemaking against NEPA. It

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[172] The eruption of Krakatoa in 1883, which killed some 36,000 humans, was not even the worst volcanic eruption to occur in the last 2500 years. *See* Encyclopedia Brittanica, vol. K at 498-99.

[173] Lord Rothschild estimates the risk of dying from influenza in a single year is 55 times as great as that of dying as a result of a nuclear power station disaster in a country where there are 100 nuclear plants. *See* Rothschild, note 169 *supra*, at 22 col. 6.

announces that uncertainties, even though inherent in the projections underlying environmental risk identification itself, must be considered as a separate category of environmental *cost*. It holds further that consideration of these uncertainties, however otherwise obvious and clearly disclosed in the rulemaking record, is insufficient if not made in a particular form or yielding a "usable" result—which in the last analysis is simply a result satisfactory to this court. Such a standard is clearly not mandated by NEPA and cannot be judicially foisted upon the Commission, however noble Judge Bazelon's intentions.

In view of the limited purposes of the fuel cycle rule, the other proceedings concurrently being conducted by the NRC, the overall conservatism of Table S-3, the massive record before us, and the rationale clearly stated in the Commission's statement of basis and purpose, I cannot say that the Commission acted arbitrarily and capriciously in promulgating its final rule. The Commission acted well within the scope of its authority throughout the S-3 proceeding; it faithfully observed all statutorily required procedures; and it acted reasonably both in adopting the assumption of complete repository integrity and in generically considering the uncertainties surrounding long-term fuel cycle impacts.

This is a rare case indeed. The Supreme Court has already unanimously mandated both the standard and the intensity by which we should scrutinize the very agency action being challenged. Faithful observance of that mandate demands that we now find that the agency's rule was reasonable. The majority has not done so. The decision and the stated rationale on which it is based, taken in conjunction with the recent action of this court in halting all operation at undamaged Three Mile Island Unit 1 on the basis of another completely novel theory, signal that this court has effectively taken over control of the nuclear industry. This is not the way I read either the substantive law or a judicial commission.

UNITED STATES COURT OF APPEALS
FOR THE DISTRICT OF COLUMBIA CIRCUIT

September Term, 1981

No. 74-1586

NATURAL RESOURCES DEFENSE COUNCIL, INC. and
CONSOLIDATED NATIONAL INTERVENORS, PETITIONERS

v.

UNITED STATES NUCLEAR REGULATORY COMMISSION and
UNITED STATES OF AMERICA, RESPONDENTS

BALTIMORE GAS AND ELECTRIC CO., ET AL., INTERVENORS

No. 77-1448

NATURAL RESOURCES DEFENSE COUNCIL, INC., PETITIONER

v.

UNITED STATES NUCLEAR REGULATORY COMMISSION and
UNITED STATES OF AMERICA, RESPONDENTS

BALTIMORE GAS AND ELECTRIC COMPANY, ET AL.,
COMMONWEALTH EDISON COMPANY,
PACIFIC LEGAL FOUNDATION, INTERVENORS

No. 79-2110

THE STATE OF NEW YORK, PETITIONER

v.

UNITED STATES NUCLEAR REGULATORY COMMISSION and
UNITED STATES OF AMERICA, RESPONDENTS
COMMONWEALTH EDISON COMPANY, ET AL.,
TENNESSEE VALLEY AUTHORITY,
BALTIMORE GAS AND ELECTRIC CO., ET AL.,
STATE OF WISCONSIN, INTERVENORS

No. 79-2131

NATURAL RESOURCES DEFENSE COUNCIL, INC., PETITIONER

v.

UNITED STATES NUCLEAR REGULATORY COMMISSION and UNITED STATES OF AMERICA, RESPONDENTS

COMMONWEALTH EDISON COMPANY, ET AL.,
TENNESSEE VALLEY AUTHORITY,
BALTIMORE GAS AND ELECTRIC COMPANY, ET AL.,
INTERVENORS

Petitions for Review of Orders of the Nuclear Regulatory Commission

[Filed Apr 27 1982]

Before: BAZELON, *Sneior Circuit Judge*, GEORGE C. EDWARDS, JR.,* *Chief Judge* for the Sixth Circuit, and WILKEY, *Circuit Judge*

AMENDED JUDGMENT

These causes came on to be heard on petitions for review of orders of the Nuclear Regulatory Commission and were argued by counsel. On July 21, 1976, this Court entered a judgment which set aside the Rule under review, and remanded to the Commission all matters relating to the operating license which the Commission had granted for the Vermont Yankee Nuclear Power Station with instructions to await the outcome of further rulemaking proceedings. 178 U.S. App. D.C. 336, 547 F.2d 633. Thereafter, the Supreme Court of the United States issued a writ of certiorari and the case was briefed and argued before that Court. On April 3, 1978, the Supreme Court reversed this Court's earlier decision in part, and remanded the case for further proceedings consistent with its opinion. *Vermont Yankee Nuclear Power Corp.* v.

* Sitting by designation pursuant to Title 28 U.S.C. § 291(a).

NRDC, 435 U.S. 519. The mandate was returned to this Court in due course. Numerous briefs and other pleadings were filed by the parties and the case was reargued before the panel on September 17, 1980. Upon consideration of all of the foregoing, it is

ORDERED AND ADJUDGED, by this Court, that the orders of the Nuclear Regulatory Commission under review herein are vacated and these cases are remanded for further proceedings consistent with the opinion of this Court filed herein this date.

Per Curiam

FOR THE COURT:

/s/ George A. Fisher
GEORGE A. FISHER
Clerk

Dated: April 27, 1982

Opinion for the Court filed by Senior Circuit Judge Bazelon.

Opinion concurring in part and dissenting in part filed by Chief Judge Edwards.

Dissenting opinion filed by Circuit Judge Wilkey.

Notice: This opinion is subject to formal revision before publication in the Federal Reporter or U.S.App.D.C. Reports. Users are requested to notify the Clerk of any formal errors in order that corrections may be made before the bound volumes go to press.

United States Court of Appeals

FOR THE DISTRICT OF COLUMBIA CIRCUIT

No. 74-1586

NATURAL RESOURCES DEFENSE COUNCIL, INC. and CONSOLIDATED NATIONAL INTERVENORS, PETITIONERS

v.

UNITED STATES NUCLEAR REGULATORY COMMISSION and UNITED STATES OF AMERICA, RESPONDENTS

BALTIMORE GAS AND ELECTRIC CO., et al., INTERVENORS

And consolidated Case Nos. 77-1448, 79-2110 and 79-2131

On Petition for Rehearing

Filed June 30, 1982

Before: BAZELON, *Senior Circuit Judge*; GEORGE C. EDWARDS, JR.*, *Chief Judge*, United States

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* Sitting by designation pursuant to Title 28 U.S.C. § 291(a).

Bills of costs must be filed within 14 days after entry of judgment. The court looks with disfavor upon motions to file bills of costs out of time.

Court of Appeals for the Sixth Circuit; and
WILKEY, *Circuit Judge*

ORDER

Upon consideration of the petitions for rehearing filed by respondents and by intervenors Commonwealth Edison Company, et al., and Pacific Legal Foundation, it is

ORDERED, by the Court, that the aforesaid petitions are denied.

Per Curiam

FOR THE COURT:

GEORGE A. FISHER
Clerk

Statement of Senior Circuit Judge Bazelon as to why he voted to deny rehearing, attached.

Judge Wilkey's position is set forth in his statement attached to the *en banc* order entered this date.

Statement of *Senior Circuit Judge* BAZELON as to why he voted to deny rehearing.

In voting to deny these petitions for rehearing, I have carefully considered the parties' arguments and have concluded that no issue has been raised that has not been addressed in our opinion. I think it worthwhile, however, to respond briefly to the salient points of the petitions.

The petitioners assert, first, that we have prescribed procedures by which the NRC must consider the environmental impact of fuel-cycle activities, and second, that we have substituted our judgment for that of the NRC. In fact, we did neither. We held only that the NRC's environmental consideration must conform with the mandate of NEPA, as interpreted in *Calvert Cliffs Coordinating Committee, Inc. v. AEC*, 449 U.S. 1109 (D.C.Cir. 1971).

In addition, the NRC states that "[t]he panel envisaged a procedure in which waste disposal uncertainties would be *quantified* as costs. . . ." NRC Petition at 10 (emphasis added). We said nothing about quantification; we said only that uncertain environmental costs must be considered in such a manner that they can potentially affect the ultimate decision to take an action. The Commission further argues that, under NEPA, an agency should be able to assess environmental costs in the abstract and subsequently exclude them entirely from consideration when the decision is being made whether to go forward with a project. *Id.* at 11. We held, and I strongly believe, that this type of consideration violates NEPA, and if permitted, would eviscerate the procedural regiment that NEPA established. As this court stated in *Calvert Cliffs*, NEPA requires that "environmental issues be considered at every important stage in the decisionmaking process concerning a particular action—at every stage where an overall balancing of environmental and nonenvironmental factors is appropriate and where alterations might be made in the proposed action to minimize environmental costs." 449 F.2d at 1118.

United States Court of Appeals

FOR THE DISTRICT OF COLUMBIA CIRCUIT

No. 74-1586

NATURAL RESOURCES DEFENSE COUNCIL, INC. and CONSOLIDATED NATIONAL INTERVENORS, PETITIONERS

v.

UNITED STATES NUCLEAR REGULATORY COMMISSION and UNITED STATES OF AMERICA, RESPONDENTS

BALTIMORE GAS AND ELECTRIC CO., et al., INTERVENORS

And consolidated Case Nos. 77-1448, 79-2110 and 79-2131

On Suggestion for Rehearing En Banc

Filed June 30, 1982

Before: ROBINSON, *Chief Judge*; BAZELON, *Senior Circuit Judge*; WRIGHT *, *Circuit Judge*; GEORGE C. EDWARDS, JR.**, *Chief Judge*, United States Court of Appeals for the Sixth Circuit; WILKEY, WALD, MIKVA and GINSBURG, *Circuit Judges*

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* Circuit Judge Wright did not participate in making this order.

** Sitting by designation pursuant to Title 28 U.S.C. § 291(a).

ORDER

The suggestions for rehearing *en banc* filed by respondents and by intervenors Comomnwealth Edison Company, et al., Pacific Legal Foundation, and Baltimore Gas & Electric Company, et al., have been circulated to the full Court and no member of the Court has requested the taking of a vote thereon. On consideration of the foregoing, it is

ORDERED, by the Court, *en banc*, that the aforesaid suggestions are denied.

Per Curiam

FOR THE COURT:

GEORGE A. FISHER
Clerk

Judge Wilkey does not ask for *en banc* consideration because he believes nothing should delay consideration of this case by the Supreme Court. Judges Tamm, MacKinnon, Harry T. Edwards and Bork are recused.

UNITED STATES COURT OF APPEALS
FOR THE DISTRICT OF COLUMBIA CIRCUIT

September Term, 1981

No. 74-1586

NATURAL RESOURCES DEFENSE COUNCIL, INC. AND CONSOLIDATED NATIONAL INTERVENORS, PETITIONERS

v.

UNITED STATES NUCLEAR REGULATORY COMMISSION AND UNITED STATES OF AMERICA, RESPONDENTS

BALTIMORE GAS AND ELECTRIC CO., ET AL., INTERVENORS

and Consolidated Cases

[Filed Sep 1 1982]

Before: BAZELON, *Senior Circuit Judge*; GEORGE C. EDWARDS, JR.*, *Chief Judge*, United States Court of Appeals for the Sixth Circuit; and WILKEY, *Circuit Judge*

ORDER

Upon consideration of intervenors' (Baltimore Gas and Electric Company, et al. and Commonwealth Edison Company, et al.) and respondents' (NRC and USA) motions for stay of mandate, of petitioner's (NRDC) response in opposition thereto, and of respondents' and intervenors' replies to the foregoing, it is

ORDERED, by the Court, that the aforesaid motions for stay of mandate are granted and the Clerk is directed not to issue the mandate herein for a period of thirty (30) days from the date of this order.

Per Curiam

FOR THE COURT:

/s/ George A. Fisher
GEORGE A. FISHER
Clerk

* Sitting by designation pursuant to Title 28 U.S.C. § 291(a).

UNITED STATES COURT OF APPEALS
FOR THE DISTRICT OF COLUMBIA CIRCUIT

September Term, 1981

No. 74-1586

NATURAL RESOURCES DEFENSE COUNCIL, INC. and CONSOLIDATED NATIONAL INTERVENORS, PETITIONERS

v.

UNITED STATES NUCLEAR REGULATORY COMMISSION and UNITED STATES OF AMERICA, RESPONDENTS

BALTIMORE GAS AND ELECTRIC CO., ET AL., INTERVENORS

And Consolidated Case Nos. 77-1448, 79-2110 and 79-2131

[Filed Sep 10 1982]

BAZELON, *Senior Circuit Judge*, and GEORGE C. EDWARDS, JR.,* *Chief Judge*, United States Court of Appeals for the Sixth Circuit.

ORDER

It is ORDERED, by the Court, that the Opinion for the Court filed in the captioned cases on April 27, 1982 be, and it is hereby, amended as follows:

> Wherever reference is made to *Calvert Cliffs' Coordinating Committee, Inc.* v. *AEC*, 449 F.2d 1109 (D.C. Cir. 1971), by use of the term "Calvert Cliffs", an apostrophe shall be inserted immediately following the letter "s" so that the reference shall be to "Calvert Cliffs'."

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* Sitting by designation pursuant to 28 U.S.C. § 291(a).

Page 3, line 4—strike "Stephen E. Eilperin" and insert in lieu thereof "Stephen F. Eilperin".

Page 3, line 31—"apperances" should read "appearances".

Page 29, line 4—substitute opening quotation marks for the closing quotation marks on the word "not".

Page 37, footnote 100, fourth line—strike "Wilkey op. at 56," and insert in lieu thereof "Wilkey op. at 45-47,"

Page 48, footnote 133, line 3—strike "Amicus Commonwealth Edison *et al.*" and insert in lieu thereof "Intervenor-Respondent Commonwealth Edison *et al.*"

Per Curiam

FOR THE COURT

/s/ George A. Fisher
GEORGE A. FISHER
Clerk

UNITED STATES COURT OF APPEALS
FOR THE DISTRICT OF COLUMBIA

September Term, 1981

No. 74-1586

NATURAL RESOURCES DEFENSE COUNCIL, INC. and CONSOLIDATED NATIONAL INTERVENORS, PETITIONERS

v.

UNITED STATES NUCLEAR REGULATORY COMMISSION and UNITED STATES OF AMERICA, RESPONDENTS

BALTIMORE GAS AND ELECTRIC CO., ET AL., INTERVENORS

And Consolidated Case Nos. 77-1448, 79-2110 and 79-2131

[Filed Sep 10 1982]

Before: WILKEY, *Circuit Judge.*

ORDER

It is ORDERED, by the Court, that the dissenting opinion filed by Circuit Judge Wilkey in the captioned case on April 27, 1982, be and it is hereby, amended as follows:

Page 3, n.6—Strike "Section III E" and substitute "Section IV D".

Strike "Sections III A-D" and substitute "Sections IV A-C".

Strike "disposition found on pages 68-69" and substitute "disposition found on page 69".

Page 8, line 12—Strike "an" and substitute "in".

Page 42, line 2—Strike "crystall ball" and substitute "crystal ball".

Page 45, line 10—Strike "built" and substitute "developed".

Page 48, lines 13-14—Strike "assessed" and substitute "measured".

Page 49, n.143—Strike "Bazelon op. at 49" and substitute "*Id.* at 49".

Page 50, line 6—Delete quotation marks from the word "usable".

Page 54 n. 153—Strike "*Id.* at 68" and substitute "*Id.* at 69".

Page 61 n. 167—In the title to the Cohen article, strike the word "Percent" and substitute "Present".

Page 63 n.171—Insert comma after "note 165" so that last line reads "Cohen, *supra* note 165, at 714-15".

PER CURIAM

/s/ George A. Fisher
GEORGE A. FISHER
Clerk

UNITED STATES COURT OF APPEALS
FOR THE DISTRICT OF COLUMBIA CIRCUIT

September Term, 1976

No. 77-1448

NATURAL RESOURCES DEFENSE COUNCIL, PETITIONER

v.

UNITED STATES NUCLEAR REGULATORY COMMISSION and
UNITED STATES OF AMERICA, RESPONDENTS
CONSOLIDATED EDISON COMPANY OF
NEW YORK, INC., ET AL.
BALTIMORE GAS AND ELECTRIC COMPANY, ET AL.

[Filed Jul 21 1977]

ORDER

Upon consideration of petitioner's motion to hold petition for review in abeyance, and of the response thereto, it is

ORDERED that the aforesaid motion is granted and the time for filing the certified record herein is extended until 30 days after final decision by the Supreme Court of the United States in *Natural Resources Defense Council v. Nuclear Regulatory Commission*, —— U.S. App. D.C. ——, 547 F.2d 633 (1976), *cert. granted*, 45 U.S.L.W. 3554 (February 22, 1977).

FOR THE COURT

GEORGE A. FISHER
Clerk

By: /s/ Daniel M. Cathey
DANIEL M. CATHEY
First Deputy Clerk

UNITED STATES COURT OF APPEALS FOR THE DISTRICT OF COLUMBIA CIRCUIT

September Term, 1977

No. 73-2266

THE LLOYD HARBOR STUDY GROUP, INC., PETITIONER

v.

NUCLEAR REGULATORY COMMISSION and UNITED STATES OF AMERICA, RESPONDENTS

THE LONG ISLAND LIGHTING COMPANY, INTERVENOR

No. 73-1776

NELSON AESCHLIMAN, ET AL., PETITIONERS

v.

UNITED STATES OF AMERICA NUCLEAR REGULATORY COMMISSION and THE UNITED STATES OF AMERICA, RESPONDENTS

CONSUMER POWER COMPANY, a Michigan Corporation, INTERVENOR

and consolidated case No. 73-1867

No. 74-1385

NATURAL RESOURCES DEFENSE COUNCIL, INC., ET AL., PETITIONERS

v.

UNITED STATES NUCLEAR REGULATORY COMMISSION and THE UNITED STATES OF AMERICA, RESPONDENTS

VERMONT YANKEE NUCLEAR POWER CORPORATION, INTERVENOR

and consolidated case No. 74-1586

No. 77-1448

NATURAL RESOURCES DEFENSE COUNCIL, PETITIONER

v.

UNITED STATES NUCLEAR REGULATORY COMMISSION and UNITED STATES OF AMERICA, RESPONDENTS

CONSOLIDATED EDISON COMPANY OF NEW YORK, INC., ET AL.
BALTIMORE GAS AND ELECTRIC COMPANY, ET AL.,
COMMONWEALTH EDISON COMPANY, ET AL.

No. 77-1905

COALITION FOR THE ENVIRONMENT, ST. LOUIS REGION and UTILITY CONSUMERS COUNCIL OF MISSOURI, PETITIONERS

v.

UNITED STATES NUCLEAR REGULATORY COMMISSION and UNITED STATES OF AMERICA, RESPONDENTS

UNION ELECTRIC COMPANY, INTERVENOR

[Filed Jun 7 1978]

ORDER

The decision of the United States Supreme Court in *Vermont Yankee Nuclear Power Corp. v. NRDC* and *Consumer Power Co. v. Aeschliman* finally disposes of various issues in these proceedings. Additionally, this Court's opinion and judgment in Nos. 73-1776 and 73-1867, and its order in No. 73-2266, finally disposes of issues which were not presented to the Supreme Court for review. However, each of these cases also concerns the adequacy of Commission rules, both past and present, governing the environmental effects of the nuclear fuel cycle and, in several cases, the application of these rules to

specific facilities. The Supreme Court has remanded Nos. 73-2266, 73-1776 and 73-1867, and 74-1385 and 74-1586 to this Court so that it may consider whether the Commission's nuclear fuel cycle rule is arbitrary or capricious within the meaning of section 706 of the Administrative Procedure Act.

The Court has decided it should hear from the parties before determining whether and how to proceed with these matters and requests the parties to report to the Court on the matters described below. Additionally, the Court must decide how to proceed with the motion of the Nuclear Regulatory Commission, filed June 2nd, 1978, to dismiss the petitions for review in Nos. 74-1385 and 74-1586. The information requested below may be relevant to that decision.

1. The current status of the facilities and proceedings involved in these cases.

2. The nature and status of the Commission's consideration of final rules relating to the environmental impact of the nuclear fuel cycle.

3. Whether the Court should proceed to decide any of these cases and, if so, what issue or issues should be decided, what provisions for briefing should be made, and whether any of these cases should be consolidated or decided by the same panel.

4. Whether, if the Court proceeds to consider the nuclear fuel cycle issue, it should take any further action in the form of partial judgments to dispose of issues concluded by the Supreme Court or by the prior opinions and orders of this Court and, if so, what the content of these judgments should be.

5. The action the Court should take on pending motions.

6. The identity and status of any cases with issues related to the ones captioned above.

7. Any other suggestions which the parties may have as to the timing and nature of further proceedings so as to facilitate the making of sound decisions in these cases.

Respondents and intervenors supporting respondents should file their memorandum within 20 days after this order. Petitioners may respond 20 days thereafter. At that time, petitioners in Nos. 74-1385 and 74-1586 should respond to the motion of the Nuclear Regulatory Commission to dismiss the petitions for review in those cases.

The time to file the certified index in No. 77-1448 is extended until further order of this Court.

For the Court:

/s/ George A. Fisher
GEORGE A. FISHER
Clerk

UNITED STATES COURT OF APPEALS
FOR THE DISTRICT OF COLUMBIA CIRCUIT

September Term, 1978

No. 74-1385

NATURAL RESOURCES DEFENSE COUNCIL, INC., ET AL., PETITIONERS

v.

UNITED STATES NUCLEAR REGULATORY COMMISSION and UNITED STATES OF AMERICA, RESPONDENTS

VERMONT YANKEE NUCLEAR POWER CORP., INTERVENOR

and consolidated case No. 74-1586

[Filed Nov 16 1978]

Before: BAZELON and TAMM, *Circuit Judges*, EDWARDS, *U.S. Circuit Judge* for the Sixth Circuit *

ORDER

On consideration of the record and the submissions of the parties, it is ORDERED that these cases be held in abeyance pending the issuance of a final fuel cycle rule. Commission counsel should report to the court at ninety (90) day intervals on the status of the rulemaking.

PER CURIAM

/s/ George A. Fisher
GEORGE A. FISHER
Clerk

Judge Bazelon reserves the right to file a statement in connection with this order.

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* Sitting by designation pursuant to 28 U.S.C. § 294(d).

UNITED STATES COURT OF APPEALS
FOR THE DISTRICT OF COLUMBIA CIRCUIT

September Term, 1978

No. 77-1448

NATURAL RESOURCES DEFENSE COUNCIL, PETITIONER

v.

UNITED STATES NUCLEAR REGULATORY COMMISSION, RESPONDENTS

No. 77-1905

COALITION FOR THE ENVIRONMENT, ST. LOUIS REGION and UTILITY CONSUMERS COUNCIL OF MISSOURI, PETITIONERS

v.

UNITED STATES NUCLEAR REGULATORY COMMISSION and UNITED STATES OF AMERICA, RESPONDENTS

UNION ELECTRIC COMPANY, INTERVENOR

[Filed Nov 20 1978]

Before: WRIGHT, *Chief Judge*

ORDER

On consideration of the record and the submissions of the parties, it is ORDERED that these cases be held in abeyance pending the issuance of a final fuel cycle rule. Commission counsel should report to the court on the status of the rulemaking in accordance with the schedule established in Nos. 73-1776 and 74-1385, and the cases consolidated with them.

UNITED STATES COURT OF APPEALS
FOR THE DISTRICT OF COLUMBIA CIRCUIT

September Term, 1978

No. 79-2110

THE STATE OF NEW YORK, PETITIONER

v.

THE NUCLEAR REGULATORY COMMISSION and
THE UNITED STATES OF AMERICA, RESPONDENTS

No. 79-2131

NATURAL RESOURCES DEFENSE COUNCIL, INC., PETITIONER

v.

UNITED STATES NUCLEAR REGULATORY COMMISSION and
UNITED STATES OF AMERICA, RESPONDENTS

[Filed Sep 28 1979]

ORDER

It is ORDERED, *sua sponte*, that these cases are consolidated.

For the Court:

GEORGE A. FISHER
Clerk

By: /s/ Daniel M. Cathey
DANIEL M. CATHEY
First Deputy Clerk

UNITED STATES COURT OF APPEALS
FOR THE DISTRICT OF COLUMBIA CIRCUIT

September Term, 1979

No. 79-2110

THE STATE OF NEW YORK, PETITIONER

v

THE NUCLEAR REGULATORY COMMISSION and
THE UNITED STATES OF AMERICA, RESPONDENTS

and consolidated case No. 79-2131

[Filed Oct 19 1979]

ORDER

On consideration of the motion of Commonwealth Edison Company, The Detroit Edison Company, Exxon Nuclear Company, Inc., Niagara Mohawk Power Corporation, Omaha Public Power District, Power Authority of the State of New York, Public Service Company of Indiana, Inc., and Rochester Gas and Electric Corporation for leave to intervene, it is

ORDERED that this motion for leave to intervene is granted.

Counsel for the intervenors are encouraged to file a joint brief with the parties they support, whenever practicable, and may participate in oral argument only to the extent allowable under Rule 12 of the General Rules of this Court.

In order to provide for maximum utilization of the provisions of Rule 28(i) of the Federal Rules of Appel-

late Procedure, in the event intervenors do not file a joint brief with the parties they support, the time for filing the brief(s) of the intervenors is extended until fifteen (15) days after the brief is filed by the principal party whose position they support. For the purposes of Rule 31(a), the time for filing the next brief will run from that date.

FOR THE COURT:

GEORGE A. FISHER
Clerk

By: /s/ Daniel M. Cathey
DANIEL M. CATHEY
First Deputy Clerk

UNITED STATES COURT OF APPEALS
FOR THE DISTRICT OF COLUMBIA CIRCUIT

September Term, 1979

No. 73-2266

THE LLOYD HARBOR STUDY GROUP, INC., PETITIONER

v.

NUCLEAR REGULATORY COMMISSION and
UNITED STATES OF AMERICA, RESPONDENTS

THE LONG ISLAND LIGHTING CO., INTERVENOR

No. 73-1776

NELSON AESCHLIMAN, ET AL., PETITIONERS

v.

UNITED STATES OF AMERICA and
NUCLEAR REGULATORY COMMISSION, RESPONDENTS

CONSUMERS POWER COMPANY,
a Michigan Corp., INTERVENOR

And Consolidated Case No. 73-1867

No. 74-1385

NATURAL RESOURCES DEFENSE COUNCIL, INC., ET AL.,
PETITIONERS

v.

UNITED STATES NUCLEAR REGULATORY COMMISSION and
THE UNITED STATES OF AMERICA, RESPONDENTS

VERMONT YANKEE NUCLEAR POWER CORP., INTERVENOR

No. 74-1586

NATURAL RESOURCES DEFENSE COUNCIL, INC., and CONSOLIDATED NATIONAL INTERVENORS, PETITIONERS

v.

UNITED STATES NUCLEAR REGULATORY COMMISSION and UNITED STATES OF AMERICA, RESPONDENTS

BALTIMORE GAS AND ELECTRIC CO., ET AL., INTERVENORS

No. 77-1448

NATURAL RESOURCES DEFENSE COUNCIL, PETITIONER

v.

UNITED STATES NUCLEAR REGULATORY COMMISSION and UNITED STATES OF AMERICA, RESPONDENTS

CONSOLIDATED EDISON COMPANY OF NEW YORK, INC., ET AL., INTERVENORS

No. 77-1905

COALITION FOR THE ENVIRONMENT, ST. LOUIS REGION and UTILITY CONSUMERS COUNCIL OF MISSOURI, PETITIONERS

v.

UNITED STATES NUCLEAR REGULATORY COMMISSION and UNITED STATES OF AMERICA, RESPONDENTS

UNION ELECTRIC COMPANY, INTERVENOR

No. 79-2110

THE STATE OF NEW YORK, PETITIONER

v.

NUCLEAR REGULATORY COMMISSION and
THE UNITED STATES OF AMERICA, RESPONDENTS

COMMONWEALTH EDISON COMPANY, ET AL., INTERVENORS

And Consolidated Case No. 79-2131

[Filed Nov 27 1979]

ORDER

In orders filed in November 1978, the Court decided to hold Nos. 73-2266, 73-1776, 73-1867, 74-1385, 74-1586, 77-1448, and 77-1905 in abeyance pending the NRC's issuance of a final fuel cycle rule. On July 27, 1979, the NRC issued what it terms a "final fuel cycle rule", which petitioners in Nos. 79-2110 and 79-2131 now challenge. Accordingly, the Court now desires to proceed with these cases as expeditiously and efficiently as possible. Because the status of these proceedings may have changed significantly since the parties last reported, the Court requests concise responses to the following questions.

1. In light of the NRC's final rule, the construction and operational status of the individual reactors involved here, and the Supreme Court's decision in *Vermont Yankee Nuclear Power Corp.* v. *NRDC*, 435 U.S. 519 (1978), what live, justiciable issues remain to be litigated in each of these cases?

2. Is there any reason not to proceed at this time with review of the NRC's final rule? What are the purpose, content, and source of the "narrative explanation" that the NRC plans to accompany the first rule? What is the relationship of the proposed narrative to the final rule, as embodied by Table S-3?

3. Discuss the usefulness of the Court's considering together, and at this time, the cases that challenge the NRC's fuel cycle rules (Nos. 74-1586, 77-1448, 79-2110, and 79-2131), while holding in abeyance those that challenge individual construction permits (Nos. 73-2266, 73-1776, 73-1867, 74-1385, and 77-1905) pending final resolution of the "rules" cases.

4. Are there related cases pending before any other court? If so, how are they related and what is their status?

5. Suggest other means to aid the Court in effecting a fair and speedy disposition of these cases.

IT IS ORDERED, that petitioners and supporting intervenors shall insure that the Court receives their responses to these questions within 15 days of this order; respondents and intervenors in support shall similarly file their responses to the questions 10 days thereafter.

IT IS FURTHER ORDERED, that (1) the NRC's motion to dismiss in Nos. 74-1385 and 74-1586, and (2) the NRDC's motion to establish the record in No. 74-1385, 74-1586, and 77-1448 are denied without prejudice.

IT IS FURTHER ORDERED, that petitioners' motions to enforce the mandate and for injunctive relief in Nos. 73-1776 and 73-1867 (filed March 20, 1978) are denied in light of the Supreme Court's judgment in *Vermont Yankee*, *supra*; and that, accordingly, the mandate in Nos. 73-1776 and 73-1867 is recalled.

IT IS FURTHER ORDERED, that (1) the motions of the Tennessee Valley Authority and Baltimore Gas and Electric Company, et al., for leave to intervene in Nos. 79-2110 and 79-2131, and (2) motion of the State of Wisconsin for leave to intervene in No. 79-2110 are granted.

IT IS FURTHER ORDERED, that the NRC's motion for leave to file out of time its opposition to the NRDC request for commencement and expedited completion of review in Nos. 74-1385, 74-1586, and 77-1448 is granted.

IT IS FURTHER ORDERED, that the NRC's motion for an extension of time in which to reply to NRDC's motion to hold No. 79-2131 in abeyance is denied but treated as the NRC's response to the NRDC motion.

IT IS FURTHER ORDERED, that briefing in Nos. 79-2110 and 79-2131 is deferred until subsequent Court order. And it is

FURTHER ORDERED, that ruling on NRDC's (1) motion to commence and expedite review in Nos. 74-1385, 74-1586, and 77-1448, and (2) motion to hold in abeyance No. 79-2131 is deferred pending further Court order.

FOR THE COURT:

/s/ George A. Fisher
GEORGE A. FISHER
Clerk

UNITED STATES COURT OF APPEALS FOR THE DISTRICT OF COLUMBIA CIRCUIT

September Term, 1979

No. 74-1586

NATURAL RESOURCES DEFENSE COUNCIL, INC., and CONSOLIDATED NATIONAL INTERVENORS, PETITIONERS

v.

UNITED STATES NUCLEAR REGULATORY COMMISSION and UNITED STATES OF AMERICA, RESPONDENTS

BALTIMORE GAS AND ELECTRIC CO., ET AL., INTERVENORS

And Consolidated Case No. 74-1385

No. 77-1448

NATURAL RESOURCES DEFENSE COUNCIL, PETITIONER

v.

UNITED STATES NUCLEAR REGULATORY COMMISSION and UNITED STATES OF AMERICA, RESPONDENTS

CONSOLIDATED EDISON COMPANY OF NEW YORK, INC., ET AL., INTERVENORS

No. 79-2110

THE STATE OF NEW YORK, PETITIONER

v.

THE NUCLEAR REGULATORY COMMISSION and THE UNITED STATES OF AMERICA, RESPONDENTS

COMMONWEALTH EDISON COMPANY, ET AL., INTERVENORS

And Consolidated Case No. 79-2131

[Filed Feb 11 1980]

Before: BAZELON, *Senior Circuit Judge*; EDWARDS *, *Chief Judge*, United States Court of Appeals for the Sixth Circuit; and TAMM, *Circuit Judge*

* Sitting by designation pursuant to Title 28 U.S.C., § 291(a).

ORDER

IT IS ORDERED, by the Court, that Appeal Nos. 74-1586, 77-1448, 79-2110 and 79-2131 are consolidated for all purposes; and it is

FURTHER ORDERED, by the Court, that the following schedule for filings with this Court is established for the above-mentioned cases:

(a) within 20 days from the date of this order, the parties shall file with the Court a stipulation as to the record for these cases. The parties should at that time identify to the Court those materials, if any, as to which they cannot agree to include in the record.

(b) within 30 days thereafter, petitioners and intervenors in support of petitioners shall file and serve their briefs.

(c) within 30 days thereafter respondent and intervenors in support of respondent shall file and serve their briefs.

(d) within 14 days thereafter, petitioners and intervenors in support of petitioners shall file and serve their reply briefs.

(e) within 14 days thereafter, petitioners shall file their appendices. Petitioners need not resubmit materials previously filed as the appendix for No. 74-1586.

And it is,

FURTHER ORDERED, by the Court, that these cases will be scheduled for argument as soon after that time as the business of the Court permits.

Per Curiam

FOR THE COURT:

/s/ George A. Fisher
GEORGE A. FISHER
Clerk

UNITED STATES COURT OF APPEALS FOR THE DISTRICT OF COLUMBIA CIRCUIT

September Term, 1979

No. 74-1586

NATURAL RESOURCES DEFENSE COUNCIL, INC., and CONSOLIDATED NATIONAL INTERVENORS, PETITIONERS

v.

UNITED STATES NUCLEAR REGULATORY COMMISSION and UNITED STATES OF AMERICA, RESPONDENTS

BALTIMORE GAS AND ELECTRIC CO., ET AL., INTERVENORS

And Consolidated Case Nos. 77-1448, 79-2110 and 79-2131

[Filed Mar 12 1980]

Before: BAZELON, *Senior Circuit Judge*; EDWARDS *, *Chief Judge*, United States Court of Appeals for the Sixth Circuit; and TAMM, *Circuit Judge*

ORDER

Upon consideration of intervenor's (Vermont Yankee) motion for clarification of this Court's order filed February 11, 1980, consolidating Appeal Nos. 74-1586, 77-1448, 79-2110 and 79-2131, it is

ORDERED, by the Court, that Intervenor's aforesaid motion for clarification is granted, and the order of this Court, entered February 11, 1980, is amended so as to provide that the filing requirements set forth in that order have no application to Appeal No. 74-1385—*Nat-*

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* Sitting by designation pursuant to Title 28 U.S.C. § 291(a).

ural Resources Defense Council, Inc., et al. v. *United States Nuclear Regulatory Commission*, et al.

Per Curiam

FOR THE COURT:

/s/ George A. Fisher
GEORGE A. FISHER
Clerk

UNITED STATES COURT OF APPEALS
FOR THE DISTRICT OF COLUMBIA CIRCUIT

September Term, 1979

No. 74-1586

NATURAL RESOURCES DEFENSE COUNCIL, INC., and
CONSOLIDATED NATIONAL INTERVENORS, PETITIONERS

v.

UNITED STATES NUCLEAR REGULATORY COMMISSION and
UNITED STATES OF AMERICA, RESPONDENTS

BALTIMORE GAS AND ELECTRIC CO., ET AL.

Appeal No. 77-1448

NATURAL RESOURCES DEFENSE COUNCIL, PETITIONER

v.

UNITED STATES NUCLEAR REGULATORY COMMISSION and
UNITED STATES OF AMERICA, RESPONDENTS

BALTIMORE GAS AND ELECTRIC COMPANY,
ET AL., INTERVENORS

Appeal No. 79-2110

THE STATE OF NEW YORK, PETITIONER

v.

THE NUCLEAR REGULATORY COMMISSION and
THE UNITED STATES OF AMERICA, RESPONDENTS

COMMONWEALTH EDISON COMPANY, ET AL., INTERVENORS

Appeal No. 79-2131

NATURAL RESOURCES DEFENSE COUNCIL, INC., PETITIONER

v.

UNITED STATES NUCLEAR REGULATORY COMMISSION and UNITED STATES OF AMERICA, RESPONDENTS

COMMONWEALTH EDISON COMPANY, ET AL., INTERVENORS

[Filed Aug 13 1980]

ORDER

The parties are requested to file simultaneous memoranda by noon, Sept. 5, 1980, addressing the following questions propounded by the court. Responses should be brief and make precise citations to the administrative record where appropriate.

I. To what extent are the following propositions still at issue between the parties?

A. For the categories set out in the Original, Interim, and Final Tables S-3, the impact values listed represent the best estimates obtainable by the Commission at the time the Rules were promulgated.

B. The combined Fuel Cycle Rulemakings were adequate to support those values.

C. The Final Rule adequately provided for treating environmental effects in subsequent licensings.

D. Uncertainties were adequately considered within the Final Rulemaking itself (*i.e.*, apart from the Rule's precluding consideration of uncertainties in subsequent licensings).

II. The Original and Interim Rules provided that no discussion of fuel cycle effects beyond the listing of Table S-3 values was to be required in individual plant environ-

mental statements. Did that provision rest on a record of clearly articulated and properly supported conclusions and findings by the Commission that:

A. the National Environmental Policy Act (NEPA) requires no further discussion because the impacts listed in Table S-3 would not "significantly affect[] the quality of the human environment," NEPA § 102(2)(C), 42 U.S.C. § 4332(2)(C) (1970)?

B. NEPA requires no further discussion because the impacts listed in Table S-3 are incapable of tipping the cost/benefit balance in the licensing of any power reactor?

C. NEPA requires no further discussion because Petitioners made no adequate showing that Table S-3 impacts would significantly affect the quality of the human environment and made no demand for a fuller discussion of environmental effects?

D. The Commission was at all times prepared to permit further discussion of environmental effects and never actually prevented such discussion, either in generic or in individual proceedings?

E. NEPA permits preclusion of further discussion in the circumstances of these Rules?

Cite the specific evidence and reasoning that would adequately support these or other conclusions—drawn and articulated by the Commission—upon which the provision in question might lawfully rest.

III. The Final Rule provides that licensing boards are not to consider uncertainties in the assumption that nuclear wastes will be successfully disposed of, *i.e.*, that such wastes will remain isolated from the human environment for the full period of their detoxification. Although the Commission admits to areas of uncertainty regarding both the likelihood of finding a suitable disposal site and the

probability that it will perform as planned, the Commission concludes that the "probabilities favor" both assumptions. Can it be determined from the record whether the Commission expressly claims or unmistakably implies:

A. that the predicted set of outcomes is more probable than any other set yet identified; or

B. that it is more likely than not that the waste disposal problem will be solved; or

C. that there is significant risk that the problem will not be solved; or

E. that the uncertainties mentioned do not involve the ultimate success of waste disposal, but only, for example, the method of disposal?

Cite the specific evidence and reasoning that would adequately support these or other conclusions—drawn and articulated by the Commission—upon which the provision in question might lawfully rest.

IV. *Economic Feasibility.*

Has the Commission adequately disclosed its basis for concluding that 10 percent of reactor building and operating costs is economically feasible, according to its own definition of feasibility, as an expense for back-end fuel cycle activities? Where in the record may that basis be found?

V. *Disposition.*

A. Assuming this Court is unable to determine the Commission's basis for particular provisions in any of the three rules:

1. should the Rules be remanded to the Commission for clarification?

2. should the rules be vacated?

B. What effect would vacation of the Original and Interim Rules have on the validity of licenses granted thereunder?

C. What would be the effect on those licenses if the Final Rule were vacated as well?

D. Assuming that any or all Fuel Cycle Rules are vacated, what might this Court properly do to minimize possible harsh consequences for the licensees?

Per Curiam
FOR THE COURT

GEORGE A. FISHER
Clerk

by /s/ Robert A. Bonner
ROBERT A. BONNER
Chief Deputy Clerk

UNITED STATES COURT OF APPEALS
FOR THE DISTRICT OF COLUMBIA CIRCUIT

September Term, 1981

No. 74-1385

NATURAL RESOURCES DEFENSE COUNCIL, INC., ET AL., PETITIONERS

v.

UNITED STATES NUCLEAR REGULATORY COMMISSION and UNITED STATES OF AMERICA, RESPONDENTS

VERMONT YANKEE NUCLEAR POWER CORP., INTERVENOR

[Filed Aug 16 1982]

Before: WILKEY, WALD and GINSBURG, *Circuit Judges.*

MEMORANDUM ORDER

In *NRDC v. NRC*, —— F.2d —— (D.C. Cir. Apr. 27, 1982), this court held that the figures in the Nuclear Regulatory Commission's original, interim, and final Table S-3 rule were the result of inadequate consideration of the potential environmental impacts of nuclear waste disposal and reprocessing, and could not be relied upon to provide the necessary environmental input into operating license proceedings for nuclear facilities. We note that the NRC is currently conducting a generic proceeding to reassess the "uncertainties" in the availability of safe nuclear waste disposal methods, with which this court was most concerned in *NRDC v. NRC*. The Commission has been urged by this court to arrive at its "waste confidence" determination by June 30, 1983. *Potomac Alliance*

v. NRC, No. 80-1862 (D.C. Cir. July 20, 1982). The results of this proceeding will, in all probability, be utilized by the Commission to adjust its S-3 rule to conform to the requirements announced in *NRDC v. NRC*.

Nevertheless, Vermont Yankee currently has an operating license issued by the NRC which effectively authorizes the facility to generate radioactive waste while the license remains in force. The license was issued pursuant to an Environmental Impact Statement that incorporated Table S-3. Although we have noted that the NRC is in the process of revising the Table, the current version cannot serve as a lawful basis for assessing the environmental impact of continued operation of the Vermont Yankee facility. Accordingly, it is hereby

ORDERED that on or before September 8, 1982, each party hereto shall file a statement to show cause why this court should not issue an order remanding the matter to the NRC for reexamination of the Vermont Yankee facility's full power operating license. The statements should address with specificity the timing of the reexamination *NRDC v. NRC* mandates.

Per Curiam

UNITED STATES COURT OF APPEALS
FOR THE DISTRICT OF COLUMBIA CIRCUIT

September Term, 1981

No. 73-1776

NELSON AESCHLIMAN, ET AL., PETITIONERS

v.

UNITED STATES OF AMERICA NUCLEAR REGULATORY COMMISSION, and UNITED STATES OF AMERICA, RESPONDENTS

CONSUMERS POWER Co. a Michigan Corp. INTERVENOR

And Consolidated Case No. 73-1867

[Filed Aug 16 1982]

Before: WILKEY, WALD*, and GINSBURG, *Circuit Judges.*

MEMORANDUM ORDER [1]

In *NRDC v. NRC*, —— F.2d —— (D.C. Cir. 27 Apr. 1982), this court held that the figures in the Nuclear Regulatory Commission's original, interim, and final Table S-3 rule were the result of inadequate consideration of the potential environmental impacts of nuclear waste

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* Circuit Judge Wald did not participate in this order.

[1] [Petitioners' Note: Memorandum Orders identical to the order printed above were entered by the same panel of the D.C. Circuit on the same day in *The Lloyd Harbor Study Group, Inc. v. Nuclear Regulatory Commission and United States of America*, No. 73-2266, and *Coalition for the Environment, St. Louis Region and Utility Consumers Council of Missouri v. United States Nuclear Regulatory Commission and United States of America*, No. 77-1905.]

disposal and reprocessing, and could not be relied upon to provide the necessary enviromental input into operating license proceedings for nuclear facilities. The Supreme Court anticipated the possibility of such a result when it remanded the matter to this court in *Vermont Yankee Nuclear Power Corp.* v. *NRDC*, 435 U.S. 519 (1978). In a footnote to the Court's opinion it suggested that

> Should [the court on remand] hold the rule invalid, it appears in all probability that the Commission will proceed to promulgate a rule resulting from rule-making proceedings currently in progress. . . . In all likelihood the Commission would then be required, under compulsion of the court's order, to examine [the licenses in issue] under that new rule.

435 U.S. at 535-36 n.10.

Although the "new rule" to which the Court referred was the final S-3 rule, which was vacated in *NRDC* v. *NRC*, *supra*, we note that the NRC is currently conducting a generic proceeding to reassess the "uncertainties" in the availability of safe nuclear waste disposal methods, with which this court was most concerned in *NRDC* v. *NRC*. The Commission has been urged by this court to arrive at its "waste confidence" determination by 30 June 1983. *Potomac Alliance* v. *NRC*, No. 80-1862 (D.C. Cir. 20 July 1982). The results of this proceeding will, in all probability, be utilized by the Commission to adjust its S-3 rule to conform to the requirements announced in *NRDC* v. *NRC*.

By our understanding, construction of the facility in issue in this cause is substantially completed. Because the alleged inadequacies in the environmental considerations made in connection with the Commission's grant of the construction permit in this case may be cured in the operating license proceedings now in progress, little would be gained by requiring the NRC to reevaluate its grant of the construction license. It is therefore

ORDERED that on or before September 8, 1982 petitioners hereto shall file a statement to show cause why this court should not issue an order dismissing the petition for review of the NRC order granting the construction permit in issue and permitting the Commission to comply with the mandate of *NRDC* v. *NRC* as part of the operating license proceeding now in progress for the subject facility.

Per Curiam

Title 10 — Energy

CHAPTER I — ATOMIC ENERGY COMMISSION
PART 50 — LICENSING OF PRODUCTION AND UTILIZATION FACILITIES

Environmental Effects of the Uranium Fuel Cycle

On November 15, 1972, the Atomic Energy Commission published in the FEDERAL REGISTER a notice of consideration of possible amendments to Appendix D, Interim Statement of General Policy and Procedure: Implementation of the National Environmental Policy Act, 10 CFR Part 50, Licensing of Production and Utilization Facilities (37 FR 24191). The amendments proposed here supplement our established rules for fulfilling section 102(2)(C) procedures of NEPA. The amendments address the question whether to consider the environmental effects associated with the uranium fuel cycle in the individual cost-benefit analyses for light-water-cooled nuclear power reactors. The Atomic Safety and Licensing Appeal Board had earlier held that some such effects should be considered while others should not.[1]

The proposed amendments set forth two alternative approaches to considering the environmental effects associated with the uranium fuel cycle. Under the first, such environmental effects would not have to be considered in applicants' environmental reports and Commission detailed statements of environmental considerations since, if factored into individual cost-benefit analyses, they would be sufficiently small as not to affect significantly the resultant conclusion. Under the second alternative, the environmental effect as-

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[1] Vermont Yankee Nuclear Power Corp. (Vermont Yankee Nuclear Power Station), ALAB-56, ALAB-73 (June 6, 1972 and October 11, 1972).

sociated with the uranium fuel cycle, albeit small, would be factored into individual cost-benefit analyses in the form of numerical values derived from the instant proceeding. The second alternative has been adopted by the Commission as an effective rule, with certain clarifying and editorial changes. Insofar as this rule differs from the Appeal Board decisions in "Vermont Yankee" supra, those decisions have no further precedential significance. The Commission also notes that adoption of this amendment is without prejudice to consideration of whether or not a full generic environmental impact statement on the uranium fuel cycle should be issued pursuant to 10 CFR Parts 11 and 51 of the Commission's regulations.

The FEDERAL REGISTER notice announced the availability for comment of the "Environmental Survey of the Nuclear Fuel Cycle," dated November 1972, prepared by the Commission's Regulatory staff. This document was designed to serve as a primary data base for the proposed amendment and not as an analysis of alternatives and costs and benefits of the entire uranium fuel cycle. Indeed, certain portions of that overall fuel cycle are undergoing separate examination and are not involved in this proceeding. These include: (i) An environmental statement in support of a recommendation by the General Manager to continue the present program for developing Federal repositories for commercial high level wastes (38 FR 29350), and (ii) a separate rule making proceeding examining transportation of UO_2 fuel to and from light water reactors and transportation of solid wastes from such reactors to waste burial grounds (38 FR 3334).

In addition, another fuel cycle for light water reactors is under study by the staff. Typical programs underway on this subject include: (i) Preparation of a generic environmental impact statement concerning potential programs for

recycling plutonium in commercial light-water reactors (39 FR 5536), (ii) analysis of methods for disposal of wastes contaminated with plutonium, and (iii) an environmental analysis of the proposed amendment to 10 CFR 71 that would require significant quantities of plutonium to be shipped as a solid in packages providing at least double containment (38 FR 20482).

The survey described stages of the fuel cycle for the purpose of determining whether the cost-benefit analysis required by NEPA and our regulation (10 CFR Part 50, Appendix D) for environmental impact studies in licensing proceedings should include numbers quantifying effects of the uranium fuel cycle. The purpose of this proceeding was to make determinations as to whether certain elements should be factored into impact statements to be utilized in other proceedings; the purpose was not to undertake a full environmental review of the uranium fuel cycle. In short, this proceeding addresses a procedural question involving the implementation of NEPA's requirement for cost-benefit analyses in impact studies. For this reason, no environmental impact statement has been prepared in connection with the rule adopted today.

All interested persons were invited to submit written comments and suggestions in connection with the proposed amendments and the Environmental Survey within 60 days after publication of the notice in the FEDERAL REGISTER. In addition, an informal rule making hearing was held on February 1, 1973, to permit the presentation of written and oral views on the Environmental Survey and the alternative approaches to consideration of the environmental effects associated with the uranium fuel cycle.

On January 3, 1973, the Commission issued a Supplemental Notice setting forth the procedures which were to

be followed in the informal rule making hearing (38 FR 50). The notice stated, among other things, that since the hearing would be part of a rule making rather than an adjudicatory proceeding, the provisions of Subpart G, Rules of General Applicability, of Part 2 of the Commission's rules of practice would not be applicable and that, therefore, such procedural features as discovery and cross-examination would not be utilized. The notice provided, however, that the participants in the hearing would be subject to questioning by the presiding hearing board. The notice further provided that at the conclusion of the hearing, the record was to be held open for a period of 30 days during which time any person could file supplementary written comments deemed appropriate in light of the hearing record. After the expiration of the 30-day period, the presiding hearing board, without rendering any decision or making any recommendation, was to forward the hearing transcript to the Commission together with an identification of issues raised at the hearing.

Written comments were received from 46 individuals and organizations representing Federal and State agencies, industry, public utilities, environmental and citizen groups, and private citizens. Participants in the informal rule making hearing included the Commission's Regulatory staff; the Environmental Protection Agency; the Mapleton Intervenors of Midland, Michigan; Westinghouse Electric Corporation; Consolidated National Intervenors and the Union of Concerned Scientists, jointly; the Atomic Industrial Forum; the Consolidated Utilities, composed of fourteen utilities appearing jointly; the New York State Department of Environmental Conservation; and the Minnesota Pollution Control Agency. In addition, two individual members of the public made limited appearances.

In its "Report to the Commission by the Nuclear Fuel Cycle Hearing Board," submitted on July 6, 1973, pursuant

to a Supplemental Notice of Hearing published on January 3, 1973, the presiding hearing board identified a number of issues which it believed were raised at the hearing and in the written comments. The first issue identified concerned a challenge by CNI/UCS to the procedures used by the Commission for the hearing. That participant argued that for any rulemaking hearing dealing with the environmental effects of the nuclear fuel cycle on a generic basis to be legally valid, the hearing must incorporate the same adjudicatory procedural features used in individual production and utilization facility licensing proceedings, including the rights of discovery and cross-examination. On the basis of this contention, the participant recommended adoption of a "third alternative" which would provide for an "on-going generic hearing" requiring preparation and circulation of an environmental impact statement. Under this alternative, parties to individual reactor licensing proceedings would be permitted to participate in an "adjudicatory" rule making proceeding, the findings of which would be incorporated into the record of individual licensing hearings.

The Commission has considered this challenge to the legal validity of the present rule making proceeding and the arguments in opposition which were filed by other parties. In our view, the procedures adopted provide a more than adequate basis for formulation of the rule we adopted. All parties were fully heard. Nothing offered was excluded. The record does not indicate that any evidentiary material would have been received under different procedures. Nor did the proponent of the strict "adjudicatory" approach make an offer of proof — or even remotely suggest — what substantive matters it would develop under different procedures. In addition, we note that all documents including the Survey were available to the parties several weeks be-

fore the hearing, and the Regulatory staff, though not requested to do so, made available various drafts and handwritten notes.[2] Under all of the circumstances, we conclude that adjudicatory type procedures were not warranted here.

The second area in which issues were identified by the presiding hearing board related to the scope and depth of the underlying Environmental Survey. One issue was whether, in light of the comments in the record, substantial revision of the survey should be made prior to adoption of a final rule. Also identified was the issue of whether the Administrative Procedure Act requires reopening of the proceeding to permit comment on any revised survey and whether such reopened proceeding should be made a proceeding conducted in the manner of the original proceeding in which comment would be invited on all aspects of the nuclear fuel cycle; or whether such proceeding should be limited to comment only on the revisions to the Survey.

In discussing the issues in this area, the presiding hearing board mentioned, among other things, the factors of safeguards against sabotage and diversion of nuclear materials and plutonium handling. The board also indicated that arguments had been advanced that the Survey was unreliable with respect to high level waste disposal in that facilities for such disposal are presently non-existent.

Sabotage and diversion receive considerable attention in licensing of individual fuel cycle facilities. The issuance of any special nuclear material license involving significant quantities of such material is contingent upon a finding by the AEC that the required accountability and physical se-

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[2] Some or all of these items might not have been provided under rigid adjudicatory rules. For example, on the one occasion when CNI/UCS requested a specific document, it was promptly made available, even though it was an internal staff memorandum written for the Commissioners themselves.

curity systems are adequate to provide reasonable protection against acts of sabotage and diversion of materials. Beyond this, insofar as environmental impact is concerned, sabotage and diversion may be viewed in the context of possible contributing factors, among others, to accident conditions. The Environmental Survey does, in fact, consider a number of postulated accidents and their environmental effects. The postulated accidents thus considered in the Survey are deemed to be a reasonable representation of the environmental effects that could result from the more credible acts of sabotage.

Those aspects of the uranium fuel cycle which involve plutonium handling, namely recovery and storage, were described in the Environmental Survey. However, other forms of plutonium handling were not discussed in the survey because the survey is applicable only to light-water-power reactors using conventional uranium dioxide fuel. Reactors utilizing plutonium recycle fuel fall outside the Survey's scope of coverage and, therefore, the values in the Summary Table are inapplicable. As stated earlier, however, the Commission is presently drafting an environmental impact statement covering all aspects of the full-scale use of plutonium in light-water reactors, including the fuel cycle.

Considerable information was presented at the hearing on high level waste storage, utilizing a retrievable surface storage facility. A description was given of such facility, the normal radiological effluents, and a maximum credible accident. The estimated normal annual radiological release was 0.005 curies. Although the ultimate capacity of the facility would be about 80,000 canisters of waste, corresponding to about 8,000 annual fuel requirements (AFR), the initial capacity will be substantially less. Even if one assumed that the annual release from the facility were associated with a single annual fuel requirement, the fission

product release per annual fuel requirement would be 0.005 Ci/AFR. Since the release of solid fission products and actinides from the model reprocessing plant is estimated at 1.004 Ci/AFR, the omission of waste repository effluents from the original Environmental Survey did not materially affect the releases shown in the Summary Table. However, the 0.005 Ci/AFR value has been added to the 1.004 Ci/AFR value in the Summary Table for a combined total, when rounded off, of 1.01 Ci/AFR. While such a waste storage facility has not been constructed, preliminary conceptual designs have been developed using existing technology based on well established data and techniques.

The Commission believes that the Survey and hearing record provide an adequate data base for the regulation adopted. Revisions to the chemical effluents in Table S-3 have been made to reflect corrections or suggestions entered into the hearing record on UF_6 conversion facilities, UO_2 conversion plants and mining operations. Minor corrections with respect to radioactive effluents have been made and in no case do these corrections increase the effluent effects by more than .25 percent of natural background. To conform the table precisely to the text of the Survey, the values for iodine-129 and 131 releases have been changed from .002 and .02 curies to .0024 and .024 curies, respectively. In addition, values for exposure of workers and the general public in the transportation of radioactive materials covered in the Survey have been added to the Summary Table. To incorporate these changes, to incorporate data on the retrievable surface storage facility in high level wastes described in the hearing, and to add information suggested in comments received as a part of the hearing record, the Environmental Survey has been revised and is being issued in revised form concurrently with promulgation of this

amendment.[8] In view of the fact that these revisions are minor and reflect the record already developed, we see no occasion for reopening this proceeding.

A third area in which issues were identified by the presiding hearing board relates to the Environmental Survey's use of qualitatively styled and allegedly undefined descriptive phrases for its conclusions regarding the magnitude of the environmental impact. One issue is whether the Survey should be revised to define more precisely the magnitude and anticipated ranges of variables pertinent to an assessment of the environmental impact. The Summary Table, S-3, to be used as a basis for evaluating the environmental effects in a cost-benefit analysis for a reactor quantifies all releases, and relates maximum effects to recognizable standards where practical. The Commission believes that providing ranges of variables relevant to assessing environmental impact would serve little or no constructive purpose here since conservatism was utilized in deriving the Summary Table values, and thus, these values already reflect an environmental impact greater than that which is truly anticipated. In addition, developing a range of values would have required separate investigations of multiple factors at over 150 mines, some 19 mills, 2 conversion plants, 3 enrichment plants, and 10 fuel fabrication facilities — to arrive at a range of values augmenting numbers already reflecting substantial conservatism.

Another issue identified in this area is whether more extensive analyses of the long-term environmental effects of waste storage and disposal are necessary to sustain the validity of the conclusions in the Survey. The Commission

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[8] Among other things, the revised Survey refers to and gives excerpts from an analysis by the Environmental Protection Agency that show that the CNI/UCS analysis of the Nuclear Fuel Services operation does not accurately represent the most recent operating history of NFS.

believes that sufficient data were presented regarding engineered waste storage facilities to justify the conclusion that the contribution of waste storage and disposal to the total environmental impact of the fuel cycle is relatively insignificant. However, as more information on high level waste storage and disposal systems becomes available as a result of the environmental impact statement on high level waste storage referenced earlier, a more definitive assessment of the environmental impact can be undertaken and the Survey revised accordingly, as appropriate.

The third issue raised in this area is whether the averaging of environmental effects and the use of models for each fuel cycle step produced values sufficiently conservative to warrant the Survey's conclusion of negligible environmental impact. The "model" facilities defined for the Environmental Survey represent the true industry average for the UF_6 conversion, enrichment, and reprocessing portions of the fuel cycle. The model mill size chosen is near the upper range of mill sizes, and the major environmental effects from milling result from the airborne effluents and tailings waste disposal steps common to all mills. Choosing a relatively large mill as a basis tended to make local environmental effects large, and hence conservative. The fuel fabrication model plant is typical of two plants that produce about 60 percent of the fuel manufactured in the United States today and conservatively represents the remainder. The effluents from the model facility were estimated without taking credit for recently installed pollution-abatement equipment and the distance from the plant to the near site boundary of the model represents the smallest distance of any actual fuel fabrication plant. These model and effluent characteristics produce conservative estimates of environmental effects.

A fourth area in which the hearing board identified an issue relates to suggestions for revision and re-examination

of the Environmental Survey at periodic intervals. While the Commission agrees with the suggestions that the Survey be re-examined from time to time to appropriately accommodate new technology and information, it does not believe it necessary or advisable to impose any specific time limit. In our view, revision should be based on growth in the data base, not on any fixed and arbitrary time period. Should future revisions to the Survey necessitate changes in the Summary Table, further rule making will be undertaken and the public afforded an opportunity for comment.

A fifth issue identified by the hearing board is whether any provision should be made for exempting or limiting the applicability of a final rule insofar as pending licensing cases are concerned. In view of the fact that the environmental effects of the uranium fuel cycle have been shown to be relatively insignificant, the Commission believes that it is unnecessary to apply the amendment to applicant's environmental reports submitted prior to its effective date or to Final Environmental Statements for which Draft Environmental Statements have been circulated for comment prior to the effective date. However, Draft Environmental Statements prepared but not circulated for comment prior to the effective date will be revised in accordance with the provisions of the amendment.

The sixth issue identified is whether the Commission should re-examine the proposed "Alternatives" in light of the record of the proceeding to determine whether modifications are necessary or desirable. In reviewing the record of the rule making hearing the Commission finds general approval for its generic approach to the consideration to be given to the environmental effects associated with the uranium fuel cycle. Many participants advocated adoption of one alternative or the other, other participants proposed modified versions of the alternatives, and one participant

advocated adoption of a third alternative which was discussed earlier. After examining these proposals, and after re-examining its own proposed alternatives, the Commission has adopted a slightly modified version of Alternative 2. The Commission, as did many of the hearing participants and commentators, favors the approach of Alternative 2 over that of Alternative 1 because the former conforms with the requirements of subsections 3 and 8 of section A of Appendix D to 10 CFR Part 50 in that it quantifies, to the fullest extent practicable, the environmental effects of the uranium fuel cycle in individual cost-benefit analyses. Incorporation of the Summary Table values into cost-benefit analyses in environmental reports and detailed statements will also help to assure more complete and meaningful documents. The changes in the effective amendment are clarifying and editorial in nature.

The seventh issue identified is whether further clarification is necessary to make clear that the Environmental Survey and the Summary Table of values are purely descriptive and are not intended as operating limits which may be imposed in licensing and regulatory actions with respect to the various fuel cycle facilities. Neither the effective amendment nor the Environmental Survey state or imply that the values in the Summary Table are to be imposed as operating limits on present and future fuel cycle facilities. Such limits are established and governed by other AEC regulations, principally, the provisions of Part 20 of Title 10 of the Code of Federal Regulations, "Standards for Protection Against Radiation." Further clarification is considered unnecessary.

The presiding hearing board raised two additional items which it believed merited Commission attention. The first was more in the nature of a suggestion to the Commission that the Regulatory staff be directed to assure the ready

availability of the background references, reference materials, and various calculations which served as the basis for the conclusions in the Survey. Copies of all non-copyrighted material, together with prior drafts of the Environmental Statement marked up by the staff, and over 100 pages of handwritten calculations were given to the Public Document Room on January 5, 1973. Therefore, the Commission believes that the staff had already complied with this suggested directive by making these background references, uncopyrighted reference materials, previous drafts and the various calculations available in the AEC's Public Document Room.

The second item referred to is whether the Environmental Survey should have discussed alternative processes with regard to fuel cycle operations. The purpose of the Survey was to provide a data base from which numerical values could be derived which would reflect the environmental impact associated with the uranium fuel cycle. These values would then be factored into cost-benefit analyses for individual reactors under the alternative adopted. Whenever possible, Survey data were based on actual operating fuel cycle facilities in order to produce numerical values reflecting real or actual environmental impact. Where this was not possible, conservatism was utilized. As stated earlier, the Environmental Survey is not an impact statement, and therefore, a discussion of alternatives is not required. In addition, the Commission does not believe that the Survey is the appropriate place to discuss alternatives in view of the fact that alternatives are considered in the NEPA context in individual licensing actions on fuel cycle facilities. On the basis of the foregoing and consideration of the comments received, the record of the hearing and other factors involved, the Commission has adopted the amendment set forth below. The amendment is essentially identical to the

second alternative contained in the November 15, 1972 FEDERAL REGISTER notice (37 FR 24191), except for minor clarifying and editorial changes.

Pursuant to the Atomic Energy Act of 1954, as amended, and sections 552 and 553 of Title 5 of the United States Code, the following amendment to Appendix D to 10 CFR Part 50 is published as a document subject to codification.

1. A new subsection 15 is added to section A to read as follows:

15. (a) In applicant's environmental reports and the Commission's detailed statements for light-water-cooled nuclear power reactors, the contribution of the environmental effects of uranium mining and milling, the production of uranium hexafluoride, isotopic enrichment, fuel fabrication, reprocessing of irradiated fuel, transportation of radioactive materials and management of low level wastes and high level wastes related to uranium fuel cycle activities to the environmental costs of licensing the nuclear power reactor, shall be as set forth in the following Table S-3 of the Commission's "Environmental Survey of the Uranium Fuel Cycle." No further discussion of such environmental effects shall be required.

(b) This section does not apply to any applicant's environmental report submitted pursuant to section 4 prior to June 6, 1974, or to any Final Environmental Statement for which a Draft Environmental Statement had been circulated for comment prior to June 6, 1974.

Effective date. The foregoing amendment is effective on June 6, 1974.

(Sec. 161, Pub. L. 83-703, 68 Stat. 948; Sec. 102 Pub. Law 91-190, 83 Stat. 853; (42 U.S.C. 2201, 4332)).

Dated at Washington, D.C. this 16th day of April 1974.

For the Atomic Energy Commission.

PAUL C. BENDER,
Secretary of the Commission.

TABLE S-3. — *Summary of environmental considerations for uranium fuel cycle*

[Normalized to model LWR annual fuel requirement]

Natural resource use	Total	Maximum effect per annual fuel requirement of model 1,000 MWe LWR
Land (acres):		
Temporarily committed	63	
Undisturbed area	45	
Disturbed area	18	Equivalent to 90 MWe coal-fired powerplant.
Permanently committed	4.6	
Overburden moved (millions of MT)	2.7	Equivalent to 90 MWe coal-fired powerplant.
Water (millions of gallons):		
Discharged to air	156	≈2 percent model 1,000 MWe LWR with cooling tower.
Discharged to water bodies	11,040	
Discharged to ground	123	
Total	11,319	<4 percent of model 1,000 MWe LWR with once-through cooling.
Fossil fuel:		
Electrical energy (thousands of MW-hour)	317	<5 percent of model 1,000 MWe LWR output.
Equivalent coal (thousands of MT)	118	Equivalent to the consumption of a 45 MWe coal-fired powerplant.
Natural gas (millions of scf)	92	<0.3 percent of model 1,000 MWe energy output.
Effluents—chemical (MT):		
Gases (including entrainment):[1]		
SO_x	4,400	
NO_2[2]	1,177	Equivalent to emissions from 45 MWe coal-fired plant for a year.
Hydrocarbons	13.8	
CO	28.7	
Particulates	1,155	
Other gases:		
F-	.72	Principally from UF_6 production enrichment and reprocessing. Concentration within range of state standards—below level that has effects on human health.
Liquids:		
$SO_4^=$	10.3	From enrichment, fuel fabrication, and reprocessing steps. Components that constitute a potential for adverse environmental effect are present in dilute concentrations and receive additional dilution by receiving bodies of water to levels below permissible standards. The constitutents that require dilution and the flow of dilution water are: NH_3—600 cfs. NO_3—30 cfs. Fluoride—70 cfs.
NO_3^-	78.7	
Fluoride	12.9	
Ca^{++}	5.4	
Cl^-	8.6	
Na^+	16.9	
NH_3	11.5	
Fe	.4	
Tailings solutions (thousands of MT)	240	From mills only—no significant effluents to environment.
Solids	91,000	Principally from mills—no significant effluents to environment.
Effluents—Radiological (curies):		
Gases (including entrainment):		
Rn-222	75	Principally from mills—maximum annual dose rate <4 percent of average natural background within 5 mi of mill. Results in 0.06 man-rem per annual fuel requirement.
Ra-226	.02	
Th-230	.02	
Uranium	.032	
Tritium (thousand)	18.7	Principally from fuel reprocessing plants—Whole body dose is 6 man-rem per annual fuel requirement for population within 50 mi radius. This is <0.005 percent of average natural background dose to this population. Release from Federal Waste Repository of 0.005 Ci/yr has been included in fission products and transuranics total.
Kr-85 (thousands)	330	
I-129	.0034	
I-131	.024	
Fission products and transuranics	1.01	
Liquids:		
Uranium and daughters	2.1	Principally from milling—included in tailings liquor and returned to ground—no effluents; therefore, no effect on environment.
Ra-226	.0034	From UF_6 production—concentration 5 percent of 10 CFR 20 for total processing of 27.5 model LWR annual fuel requirements.
Th-230	.0015	
Th-234	.01	From fuel fabrication plants—concentration 10 percent of 10 CFR 20 for total processing 26 annual fuel requirements for model LWR.
Rn-109[3]	.15	From reprocessing plants—maximum concentration 4 percent of 10 CFR 20 for total reprocessing of 26 annual fuel requirements for model LWR.
Tritium (thousands)	2.5	
Solids (buried):		
Other than high level	601	All except 1 Ci comes from mills—included in tailings returned to ground—no significant effluent to the environment, 1 Ci from conversion and fuel fabrication is buried.
Thermal (billions)	3,360	<7 percent of model 1,000 MWe LWR.
Transportation (man-rem): Exposure of workers and general public	.334	

[1] Estimated effluents based upon combustion of equivalent coal for power generation.
[2] 1.3 percent from natural gas use and process.
[3] Cs-137 (0.075 Ci/AFR) and Sr-90 (0.004 Ci/AFR) are also emitted.

(FR Doc. 74-6976 Filed 4-18-74; 8:45 am)

Title 10—Energy

CHAPTER 1—NUCLEAR REGULATORY COMMISSION

PART 51—LICENSING AND REGULATORY POLICY AND PROCEDURES FOR ENVIRONMENTAL PROTECTION

Uranium Fuel Cycle Impacts From Spent Fuel Reprocessing and Radioactive Waste Management

AGENCY: Nuclear Regulatory Commission.

ACTION: Effective interim rule.

SUMMARY: The Commission has previously identified environmental impact values for the uranium fuel cycle which are to be included in environmental reports and environmental impact statements for individual light water nuclear power reactors. This rule amends the prior regulations so as to incorporate revised values, based on a new study of the available information, for the nuclear waste management and nuclear fuel reprocessing portions of the fuel cycle.

EFFECTIVE DATE: March 14, 1977.

FOR FURTHER INFORMATION CONTACT:

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SUPPLEMENTARY INFORMATION: On October 18, 1976, the Nuclear Regulatory Commission (hereafter Commission or NRC) gave notice in the FEDERAL REGISTER (41 FR 45849) that it contemplated promulgating an interim rule which would revise Table S-3 of 10 CFR Part 51 to include new specific impact values derived in light of its "Environmental Survey of the Reprocessing and

Waste Management Portions of the LWR Fuel Cycle" NUREG-0116 (Supplement 1 to WASH-1248) hereinafter referred to as "Supplement"). Interested persons were invited to submit written comments on the Supplement and proposed interim rule by December 2, 1976, copies of which are available for public inspection at the Commission's Public Document Room at 1717 H Street, N.W., Washington, D.C. 20555. After careful consideration of the comments received and within the context of the following discussion, the Commission has adopted the values set forth in the interim rule which will remain effective for eighteen months unless good cause is shown to extend the period of effectiveness.

BACKGROUND

Pursuant to the National Environmental Policy Act of 1969 (NEPA), an environmental impact statement must be prepared by the Commission in connection with issuance of a construction permit or operating license for each light water nuclear power reactor. These statements should contain a detailed evaluation of the environmental impacts of construction and operation of the plant and a discussion of reasonable alternatives, as well as an overall assessment of the costs and benefits of the licensing action.

In November 1972, a document entitled "Environmental Survey of the Nuclear Fuel Cycle" (hereinafter referred to as "Survey") was published by the Directorate of Licensing of the Atomic Energy Commission (AEC). Comments on the Survey were solicited, and an informal rulemaking hearing was held on February 1 and 2, 1973. The purpose of the hearing was to consider possible amendments to Appendix D of 10 CFR Part 50 which would, by rule, specify the environmental effects of the uranium fuel cycle to be factored into the assessment of costs and benefits in environmental impact statements for individual light water nuclear power reactors (LWR's). Written comments were received in response to the FED-

ERAL REGISTER notice, and recommendations for improvement were offered during the hearings. After consideration of the written comments and the hearing record, the AEC promulgated the final fuel cycle rule (the so-called Table S-3) on April 22, 1974 (39 FR 14188). It was intended that, with the inclusion of environmental impacts from Table S-3, the environmental impact statements for individual LWR's would set forth a full and candid assessment of costs and benefits consistent with the legal requirements and spirit of NEPA. The AEC indicated in its decision that the rule and Survey would be reexamined from time to time to accommodate new information. The same Table S-3 was included in 10 CFR Part 51.

On January 19, 1975, the Atomic Energy Commission was abolished and its licensing and regulatory responsibilities transferred to the Nuclear Regulatory Commission. On July 21, 1976, the United States Court of Appeals for the District of Columbia Circuit decided *Natural Resources Defense Council v. NRC*,[1] a case involving judicial review of the fuel-cycle rule, and *Aeschliman v. NRC*,[2] a related case involving the exclusion of fuel cycle issues from an individual power reactor licensing proceeding. The court approved the overall approach and methodology of the fuel cycle rule and found that, regarding most phases of the fuel cycle, the underlying Environmental Survey represented an adequate job of describing the impacts involved.[3] However, the court found that the rule was inadequately supported by the record insofar as

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[1] —— F.2d —— (D.C. Cir. 1976), 9 ERC 1149, *cert. granted sub nom., Vermont Yankee Nuclear Power Corp.* v. *Natural Resources Defense Council*, 45 U.S.L.W. 3570 (U.S. Feb. 22, 1977) (No. 76-419). No action has as yet been taken by the Supreme Court on a related petition for certiorari filed in *Baltimore Gas and Electric Co.* v. *Natural Resources Defense Council*, No. 76-458.

[2] —— F.2d —— (D.C. Cir. 1976), 9 ERC 1289, *cert. granted*, 45 U.S.L.W. 3570 (U.S. Feb. 22, 1977) (No. 76-528).

[3] Note 1, *supra*, at 1159.

it treated two particular aspects of the fuel cycle—the impacts from reprocessing of spent fuel and the impacts from radioactive waste management.

In response to the court decision, the Commission issued a General Statement of Policy (41 FR 34707, August 16, 1976) announcing its intention to reopen the rulemaking proceeding on the environmental effects of the fuel cycle to supplement the existing record on waste management and reprocessing impacts to determine whether the rule should be amended and, if so, in what respect.[4] The Commission thus indicated its intent to handle the question of the environmental impacts of waste management and reprocessing generically rather than in individual licensing proceedings, a decision supported by language of the court in the *Vermont Yankee* case.[5] The Commission directed the Staff to prepare on an expedited basis a well-documented supplement (NUREG-0116) to the Survey (WASH-1248) to establish a basis for identifying environmental impacts associated with fuel reprocessing and waste management activities that are attributable to the licensing of a model light-water reactor.

The revised survey was completed in October, 1976, and the Commission issued the October 18, 1976 notice regarding the proposed interim rule. The comments received in response to that notice and the Commission's responses to those comments comprise NUREG-0216, Supplement 2 to WASH-1248 (hereinafter "Supplement 2").

The Commission indicated in that notice that the values proposed therein were to be considered as a proposed interim substitute for the values originally set forth in Table S-3A of WASH 1248. After receipt and analysis of comments received, a final interim rule was to be promul-

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[4] The Court of Appeals stayed its mandate in the proceedings which gave rise to the General Statement of Policy, and the Supreme Court's grant of certiorari has the legal effect of continuing the stay of mandate in effect.

[5] Note 1, *supra*, n. 17, at 1154-1155.

gated for use in LWR licensing. The interim rule was to be made permanent only after a public hearing had been held to further facilitate effective public participation. Under a Supplemental Statement of Policy published in the FEDERAL REGISTER on November 11, 1976 (41 FR 49898) licensing of individual LWR's was resumed on a conditional basis pending promulgation of the final interim rule provided that the old values for reprocessing and waste management contained in Table S-3A were compared with the values in the proposed interim rule to determine if application of the new values would tilt the cost/benefit balance in individual cases. All values in the table except those relating to waste management and reprocessing were to remain the same.

The Commission has decided to pattern the final interim rule after the original Table S-3. Supplements 1 and 2 provide detailed narrative explanation of the new values in Table S-3 and give greater illumination to the background and context of the revised values.

SCOPE AND PURPOSE OF SUPPLEMENTS AND RULE

At the outset the Commission wishes to make clear that its purpose in preparing Supplements 1 and 2 and the interim rule was quite limited. The sole purpose of preparation of Supplement 1 and the rule was to identify and quantify environmental impacts attributable to the reprocessing and waste management portions of the LWR fuel cycle. The environmental impacts so identified are to be used only in the preparation of environmental impact statements for individual light water reactors. Supplement 1 and the rule have fulfilled this purpose. It was not the purpose of this proceeding to decide which of the various waste management alternatives should or will be employed in practice, or to develop site selection criteria or to define parameters for licensing of any of the Energy Research and Development Administration's (ERDA) waste management facilities. A separate and compre-

hensive series of programs has been undertaken to serve these broader purposes. ERDA has several programs in progress including a program for the preparation of a generic environmental impact statement on high-level waste management, a program to evaluate geologic formations and specific sites for repositories, programs in research and development of waste solidification methods and development of interim storage sites. NRC's ongoing programs include the preparation of regulations for the licensing of ERDA waste management facilities and activities, the development of performance criteria for solidified high-level waste and the development of site suitability criteria for high-level waste repositories.

These programs are described in greater detail in Appendices B and C to Supplement 1 and other agency programs are described in Appendix F to Supplement 2. Supplement 1 itself and the S-3 rule are only a very small part of these ongoing activities.

In addition to these ongoing programs the Commission has undertaken the preparation of two generic environmental impact statements on fuel cycle issues. One, the Generic Environmental Statement on Mixed Oxide Fuels, "GESMO," is in the legislative hearing stage of a rulemaking proceeding. Work has commenced on the other, the Generic Environmental Impact Statement on Uranium Milling, and a draft statement is expected in mid-1978.

The Commission has used some of the information in the GESMO document, NUREG-0002, in its preparation of Supplement 1 and the interim rule in much the same manner as it has used other available literature. While the Commission realizes that additional information may be generated during the GESMO proceeding, all of the information used in the Supplement, including the relevant information from NUREG-0002, will be re-examined during preparation of the final fuel cycle rule and will be subjected to close scrutiny during public hearings on the final rule along with other available information. To the

extent that comments in this proceeding have raised issues related to the material in the GESMO document, the Commission has independently evaluated the comments and taken them into account in this proceeding.

Sufficiency of Information and Assessment

In order to fulfill its purpose of identifying in a generic proceeding the environmental impacts attributable to the reprocessing and waste management portions of the LWR fuel cycle, the Commission had to decide whether the information produced by Supplements 1 and 2 provided a sufficient basis for proceeding with an interim rule. The Commission addressed the questioin whether the risks of proceeding on the basis of information which may later be called into question in a final rulemaking proceeding outweigh the costs which would certainly flow from a hiatus in LWR licensing. *See National Air Carrier Association v. CAB*, 436 F.2d 185, 191 (D.C. Cir. 1970). The costs attributable to a hiatus in licensing were explored by the Commission's Staff in a paper entitled "Impacts of Adopting or Not Adopting an Interim Rule Permitting Construction or Operation of Nuclear Power Plants" which was cited by the Commission in its Supplemental Statement of Policy (41 FR 49898) and placed in the Public Document Room along with NUREG-0116. The paper concluded that the environmental and economic costs attributable to a twelve-month delay in the licensing of reactors were substantial.

A number of comments on the Supplement and the proposed interim rule also dealt with the adequacy of this study. These comments are discussed in detail in the document entitled "Response to Comments on a Staff paper entitled 'Impacts of Adopting or Not Adopting an Interim Rule Permitting Construction or Operation of Nuclear Power Plants' ". In the Commission's view, the study was adequate to fulfill its limited purpose of highlighting for the Commission and others the costs of a

hiatus in licensing that would be caused by the failure to promulgate an interim rule. Even if environmental costs of a delay in licensing were excluded from consideration, the economic costs of a twelve-month delay would be high. Thus, the costs which would flow from a hiatus in licensing were explored by the Commission and the Commission has concluded that they would be substantial. However, as was noted above, costs alone could not determine the Commission's resolution of the question whether to proceed by interim rule. Against these costs must be weighed the risks of proceeding by interim rule where the sufficiency of the information supporting the rule might be later called into question during the final rulemaking proceeding on the permanent rule. Accordingly, the Commission critically examined the Supplement and, in light of some comments questioning its adequacy attempted to judge its quality.

The Supplement supporting the new interim rule (NUREG-0116) was the product of extensive effort by a Task Force comprised of a number of highly qualified individuals with years of experience in the field. Since a great deal of work in the field had already been completed when the Task Force began its analysis, the Task Force was not required to start completely fresh in its consideration of the issues. Supplement 1 is not merely an uncritical description of the available literature on the subject of reprocessing and waste management. Rather, the Task Force carefully examined voluminous amounts of information in the field, selected from those sources the best possible information available and then critically analyzed the information and, where warranted, rechecked calculations and performed independent analysis. Further, the Staff performed a detailed analysis of the comments received on the Supplement. The responses to every substantive comment received are contained in Supplement 2, NUREG-0216. Supplements 1 and 2 contain a detailed analysis of the impacts of waste management and reprocessing and provide a sufficient informational basis for the interim rule promulgated herein.

The Commission has observed that there are gaps in the information needed for detailed assessment of waste management and disposal technology. While there is the need to obtain additional data and to consider from time to time any new findings that would have a bearing upon the values set forth in Table S-3, the lack of some relevant data in certain areas by no means excuses the Commission from making an informed and reasoned judgment now regarding the environmental impacts which may flow from waste management and reprocessing activities.

The situation is analogous to the Atomic Energy Commission's issuance of interim acceptance criteria for emergency core cooling systems, as reviewed in *Union of Concerned Scientists v. AEC*, 499 F.2d 1069 (D.C. Cir. 1974). As the AEC did in that instance, the Commission recognizes that "analytical methods capable of realistic prediction of all phenomena known or suspected to occur" in the course of waste management and disposal are not available and agrees that definitive experiments have not been carried out. However, the Commission's position, which is reflected in the Task Force Report as revised, is the same as the one that was given judicial acceptance in *Union of Concerned Scientists:*

> In the absence of such perfection, adequate assurance of safety can be obtained from an appropriately conservative analysis based on available experimental information. In areas of incomplete knowledge, conservative assumptions or procedures must be applied. When further experimental information or improved calculational techniques become available, the conservatisms presently imposed will be reevaluated and a more realistic approach will be taken. 499 F.2d 1069, at 1086.

It should be noted that the interim rule does not deal with a safety question as did the emergency core cooling system but rather attempts to quantify the environmental impacts of reprocessing and waste management. "[C]on-

servative analysis based on available experimental information" is even more appropriate in such a case where the goal is not to reach a conclusion whether a level of safety has been met, but rather to develop values for use in environmental cost benefit analyses.

The Task Force Report (NUREG-0116) and the Comments and Responses (NUREG-0216) contain and document numerous conservatisms applied to the analysis of environmental impacts from waste management and reprocessing activities. In those few cases where detailed estimates could not be made, the Task Force exercised its expert judgment to reach a best estimate. Since a calculation could not be made, the conservatism of these few judgments cannot absolutely be established. However, it is the Commission's view that the impacts estimated on expert judgments are quite small in any case and that adequate conservatism has been applied.

The Commission would be reluctant to proceed if it believed the values in Table S-3, and the information from which they are derived, were called into question to any significant degree by substantial evidence, but this is not the case. *Union of Concerned Scientists*, 499 F.2d at 1085. To some extent, as noted above, the setting of values in Table S-3 involved making "policy judgments where no factual certainties exist or where facts alone do not provide the answer." *Industrial Union Department, AFL-CIO v. Hodgson*, 499 F.2d 467, 476 (D.C. Cir. 1974). In such cases—especially where the evidence is "difficult to come by, uncertain, or conflicting because it is on the frontiers of scientific knowledge"—it is appropriate for the Commission to proceed to apply its expertise; its conclusions must be rationally justified, not based on hunches or wild guesses, but conclusions may be drawn "from theoretical projections from imperfect data, from probative preliminary data not yet certifiable as 'fact', and the like." *Ethyl Corp. v. EPA*, 541 F.2d 1, 28 (D.C. Cir. 1976); see also *Amoco Oil Co. v. EPA*, 501 F.2d 722 (D.C.

Cir. 1974). The Commission may, as to some extent it has done here, make probabilistic assessments that must suffice until data becomes "sufficiently quantifiable to yield to meaningful analysis." *Union of Concerned Scientists, supra*, 499 F.2d at 1093.

The Commission has also been mindful of its obligation to identify the particular findings in the literature that it deems significant, *Portland Cement Association v. Ruckelshaus*, 486 F.2d 375, 400 (D.C. Cir. 1973), *cert. denied* 417 U.S. 921 (1974), and to examine the reasons for mistakes in prior assessments in order that its assessment may be complete. In this regard, the Commission has examined past experiences in the waste management field. There, in several instances, past scientific judgments were shown to have been in error. However, one cannot look at those mistakes without recognizing that developments in technology have since occurred which make repetition of past mistakes less likely. Past experience has provided an indication of the types of impacts that are possible. Furthermore, the Supplement is based on very conservative assumptions regarding levels of releases. The Supplement has included in its model only technologies which are presently available and the Commission has made every effort to make the most thorough evaluation of the associated environmental impacts that the present state of available knowledge will permit.

In summary, the Commission has decided to proceed with promulgation of the interim rule. It has looked at the uncertainties and unknowns identified in the Supplement. It has weighed the risks of proceeding with licensing on the basis of the interim rule against the costs of not proceeding. The Commission has found that the costs of not proceeding outweigh the risks of proceeding by interim rule especially given the fact that a relatively short period of time, eighteen months, may pass before a more thorough discussion of the issues will be completed in the final rulemaking proceeding. There is no perceived

need for the Commission to wait for site specific information or to wait for ERDA's generic environmental impact statement on high-level waste management. In some areas—including critical areas where a substantial measure of expert judgment had to be applied—it is unlikely that substantial new information of a quantitative nature will be available for years. As the Court said in *Citizens for Safe Power v. NRC*, 524 F.2d 1291, 1297 (D.C. Cir. 1975):

> Absolute or perfect assurances are not required by [the Atomic Energy Act], and neither present technology nor public policy admit of such a standard. It was for the Commission to arrive at a rational, practical and principled conclusion upon the basis of reasonably available evidence.

Interim Rulemaking

Some of the comments have raised the question whether an interim rule, without the benefit of oral hearings, is an appropriate mechanism for establishing the impacts presented in Table S-3. The Commission continues to believe that such action is fully warranted, in the light of the competing factors identified above.

The fixing of values under an interim rule is consistent with the opinion of the court in *NRDC v. NRC*, as well as settled case and statutory law. Indeed, interim rules may be adopted without any prior notice and opportunity for public comment if public procedures would be impracticable, unnecessary, or contrary to the public interest. 5 U.S.C. § 553(b). The AEC's adoption of interim acceptance criteria for emergency core cooling systems was found to be a valid exercise of this authority, for example, in *Union of Concerned Scientists, supra*, 499 F.2d at 1085.

Furthermore, the quality of the comments and of the Task Force responses to those comments as well as the additional information provided in the course of this interchange give the Commission confidence that no major

issues lie hidden as a result of this procedure. While the Commission has chosen to use notice and comment procedures for this interim rulemaking, it intends to hold public hearings in connection with the *final* rulemaking to facilitate additional effective public participation. The time, place, and format for the hearing will be set forth in a separate FEDERAL REGISTER notice. Such public hearings are, however, not required to satisfy any constitutional or statutory mandate and, therefore, the use of notice and comment procedures will suffice for interim rulemaking. In *NRDC v. NRC*, *supra*, the Court of Appeals for the District of Columbia Circuit referred neither to the Constitution nor to the Administrative Procedure Act when it set for itself the task "to decide whether the procedures provided by the agency were sufficient to ventilate the issues." 9 ERC at 1156. Rather, the court's analysis of asserted procedural inadequacies in the earlier S-3 proceedings apparently rests on judicial notions, fundamentally common-law in character, concerning what is required to produce a record that will facilitate judicial review.[6] The same court has stated, "Although we have recognized that provision of oral hearings may be wise in some instances, we have never held that due process requires oral presentation of views as a matter of course," *Pickus v. U.S. Board of Parole*, 543 F.2d 240, 246 (D.C. Cir. 1976). In circumstances calling for prompt action it follows that use of notice and comment procedures for interim rulemaking is sufficient. The Commission has made every effort to present a full statement of available information, and to explain the reasons which persuade it to adopt, for a relatively short period, the values set forth in revised Table S-3.

In order to reflect its interim character, the rule that is presently being adopted will be made effective for the limited period of eighteen months. The Commission be-

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[6] As earlier indicated in note 1, *supra*, the Supreme Court has granted certiorari in *NRDC v. NRC*.

lieves that final rulemaking proceedings can be completed within this period and wishes to stress that the present rule is only a temporary measure pending completion of the final rulemaking proceedings which will reflect additional public participation. However, if good cause is shown, the period of effectiveness of the interim rule can be extended.

The amended rule incorporating revised Table S-3 is being made effective immediately because the Commission has determined that it has good cause for doing so: the revised Table S-3 provides a more current and comprehensive basis for evaluation than does the original Table S-3; there is a need to base licensing decisions on the best available information; and the values in the interim rule are not substantially different from the values in the proposed interim rule upon which interested persons had the opportunity to comment. (Supplemental General Statement of Policy, 41 FR 49898, November 11, 1976; see also 5 U.S.C. 553(d)(3)).

Accordingly, any operating license, construction permit, or limited work authorization (LWA) that may hereafter be issued must take into account the revised values contained in this rule. Licenses, permits, or limited work authorizations issued before July 21, 1976 in which the originally effective chemical reprocessing and waste storage values of Table S-3 were utilized will remain effective, principally because the values in the new interim rule are not sufficiently different from the values in the original Table S-3 to warrant revocation or suspension on cost-benefit grounds. Any show cause or similar proceedings initiated in these cases pursuant to the August 16, 1976 General Statement of Policy will be terminated.

Operating licenses, construction permits, or limited work authorizations granted after July 21, 1976 and which therefore were subject to the outcome of the proceedings in *NRDC v. NRC*, will also remain in effect, and any show cause or similar proceedings initiated in response to

the August 16, 1976 General Statement of Policy in these cases are also to be terminated. The values in the interim rule are not substantially different from those which, under the Commission's Supplemental General Statement of Policy, were required to be considered by Atomic Safety and Licensing Boards in connection with the issuance of such licenses. Where the the Boards have found that the cost-benefit balance would not be tilted by the values in the proposed interim rule, no further proceedings are necessary since the values in the final interim rule are not substantially different from the values in the proposed rule. Similarly, cases now pending before the Boards in which the evidentiary record on fuel cycle impact issues has been compiled are to be decided on the basis of the existing record; since the interim rule values are not substantially different from those in the previously proposed rule, the reopening of the record to receive additional testimony would not appear to be justified.

Pursuant to the Atomic Energy Act of 1954, as amended, the Energy Reorganization Act of 1974, as amended, the National Environmental Policy Act of 1969, as amended, and sections 552 and 553 of Title 5 of the United States Code, the following amendment to 10 CFR Part 51 is published as a document subject to codification, to be effective on March 14, 1977.

10 CFR Part 51 is amended by revising § 51.20(e) to read as follows:

§ 51.20 Applicant's Environmental Report—Construction Permit Stage

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(e) In the Environmental Report required by paragraph (a) for light-water-cooled nuclear power reactors, the contribution of the environmental effects of uranium mining and milling, the production of uranium hexafluoride, isotopic enrichment, fuel fabrication, reprocessing of irradiated fuel, transportation of radioactive materials and management of low level wastes and high level wastes related to uranium fuel cycle activities to the environmental

costs of licensing the nuclear power reactor, shall be as set forth in Table S-3, *Summary of environmental considerations for uranium fuel cycle.* No further discussion of such environmental effects shall be required. This paragraph does not apply to any applicant's environmental report submitted prior to June 6, 1974. The values set forth in Table S-3 in this paragraph will not be applied in any proceeding as of September 14, 1978.

TABLE S-3

Summary of environmental considerations for uranium fuel cycle [1]

(Normalized to model LWR annual fuel requirement [WASH-1248] or reference reactor year [NUREG-0116])

Natural resource use	Total	Maximum effect per annual fuel requirement or reference reactor year of model 1,000 MWe LWR
Land (acres):		
Temporarily committed [2]	94	
Undisputed area	73	
Disturbed area	22	Equivalent to a 110 MWe coal-fired powerplant.
Permanently committed	7.1	
Overburden moved (millions of MT)	2.8	Equivalent to 95 MWe coal-fired powerplant.
Water (millions of gallons):		
Dicharged to air	159	=2 pct of model 1,000 MWe LWR with cooling tower.
Discharged to water bodies	11,090	
Discharged to ground	124	
Total	11,373	<4 pct of Model 1,000 MWe LWR with once-through cooling.
Fossil fuel:		
Electrical energy (thousands of megawatt hours)	321	<5 pct of model 1,000 MWe LWR output.
Equivalent coal (thousands of MT)	117	Equivalent to the consumption of a 45 MWe coal-fired powerplant.
Natural gas (millions of scf)	124	<0.3 pct of model 1,000 MWe energy output.
Effluents—chemical (MT):		
Gases (including entrainment): [3]		
SO_x	4,400	
NO_x [4]	1,190	Equivalent to emissions from 45 MWe coal-fired plant for a year.
Hydrocarbons	14	
CO	29.6	
Particulates	1,154	

Table S-3—Continued

Natural resource use	Total	Maximum effect per annual fuel requirement or reference reactor year of model 1,000 MWe LWR
Other gases:		
F-	.67	Principally from UF_6 production, enrichment, and reprocessing. Concentration within range of state standards—below level that has effects on human health.
HCl	.014	
Liquids:		
SO_4^-	9.9	From enrichment, fuel fabrication, and reprocessing steps. Components that constitute a potential for adverse environmental effect are present in dilute concentrations and receive additional dilution by receiving bodies of water to levels below permissible standards. The constituents that require dilution and the flow of dilution water are: NH_3—600 ft^3/s. NO_3—20 ft^3/s. Fluoride—70 ft^3/s.
NO_3^-	25.8	
Fluoride	12.9	
Ca^{++}	5.4	
Cl^-	8.5	
Na^+	12.1	
NH_3	10.0	
Fe	.4	
Tailings solutions (thousands of MT)	240	From mills only—no significant effluents to environment.
Solids	91,000	Principally from mills—no significant effluents to environment.
Effluents—radiological (curies):		
Gases (including entrainment):[5]		
Rn-222	74.5	Principally from milling operations and excludes contributions from mining.
Rn-222	74.5	
Ra-226	.02	
Th-230	.02	
Uranium	18.1	
Tritium (thousands)	24	
Kr-85 (thousands)	400	
Ru-106	.14	Principally from fuel reprocessing plants.
I-129	1.3	
I-131	.83	
Fission products and transuranics	.023	
Liquids:[6]		
Uranium and daughters	2.1	Principally from milling—included tailings liquor and returned to ground—no effluents; therefore, no effect on environment.

Table S-3—Continued

Natural resource use	Total	Maximum effect per annual fuel requirement or reference reactor year of model 1,000 MWe LWR
Ra-226	.0034	From UF_6 production.
Th-230	.0015	
Th-234	.01	From fuel fabrication plants—concentration 10 pct of 10 CFR 20 for total processing 26 annual fuel requirements for model LWR.
Fission and activation products	5.9×10^{-6}	
Solids (buried on site):		
Other than high level (shallow)	11,300	9,100 Ci comes from low-level reactor wastes and 1,500 Ci comes from reactor decontamination and decommissioning—buried at land burial facilities. 600 Ci comes from mills—included in tailings returned to ground. ~60 Ci comes from conversion and spent fuel storage. No significant effluent to the environment.
TRU and HLW (deep)	1.1×10^{7}	Buried at Federal repository.
Effluents—thermal (billions of British thermal units)	3,462	<4 pct of model 1,000 MWe LWR.
Transportation (person-rem):		
Exposure of workers and general public	2.5	
Occupational exposure (person-rem)	22.6	From reprocessing and waste management.

[1] Data supporting this table are given in the "Environmental Survey of the Uranium Fuel Cycle," WASH-1248, April 1974; the "Environmental Survey of the Reprocessing and Waste Management Portions of the LWR Fuel Cycle," NUREG-0116 (Supp. 1 to WASH-1248); and the "Discussion of Comments Regarding the Environmental Survey of the Reprocessing and Waste Management Portions of the LWR Fuel Cycle," NUREG-0216 (Supp. 2 to WASH-1248). The contributions from reprocessing, waste management and transportation of wastes are maximized for either of the two fuel cycles (uranium only and no recycle). The contribution from transportation excludes transportation of cold fuel to a reactor and of irradiated fuel and radioactive wastes from a reactor which are considered in Table S-4 of § 51.20(g). The contributions from the other steps of the fuel cycle are given in columns A-E of Table S-3A of WASH-1248.

[2] The contributions to temporarily committed land from reprocessing are not prorated over 30 years, since the complete temporary impact accrues regardless of whether the plant services one reactor for one year or 57 reactors for 30 years.

Effective date: The foregoing amendments take effect on March 14, 1977.

(Sec. 102, Pub. L. 91-190, 83 Stat. 853, as amended, Pub. L. 94-83, 89 Stat. 424 (42 U.S.C. 4332); Sec. 161, as amended, Pub. L. 83-703, 68 Stat. 048 (42 U.S.C. 2201); Sec. 202, Pub. L. 93-438, 88 Stat. 1244 (42 U.S.C. 5842))

Dated at Washington, D.C. this 7th day of March, 1977.

For the Nuclear Regulatory Commission

/s/ Samuel J. Chilk
SAMUEL J. CHILK
Secretary of the Commission

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[3] Estimated effluents based upon combustion of equivalent coal for power generation.

[4] 1.2 percent from natural gas use and process.

[5] Gaseous effluents from waste management contribute about 9 person-rem (total body) to offsite U.S. Population per annual fuel requirement or reference reactor year for the uranium only recycle option. This contribution for the no recycle option is 170 person-rem. For comparison, all radiological gaseous effluents from fuel cycle operations contribute about 370 person-rem (total body) to offsite U.S. population per annual fuel requirement or reference reactor year. This dose is < 0.002 percent of the average natural background radiation dose to this population. Fuel reprocessing contributes about 330 person-rem (total body) of the total of 370 person-rem to offsite U.S. population. Person-rem is an expression for the summation of whole body doses to individuals in a group. Thus, if each member of a population group of 1,000 people were to receive a dose of 0.001 rem (1 millirem), or if 2 people were to receive a dose of 0.5 rem (500 millirem) each, the total person-rem dose in each case would be 1 person-rem. The dose to the offsite U.S. population due to average natural background radiation is about 2×10^7 person-rem per year. The Commission's final environmental statement on use of mixed-oxide fuel in LWRs (NUREG-0002) indicates a maximum release of about 4800 Ci of Rn-222 when contributions from mining are included. NUREG-0002 also indicates that mining contributes about 500 person-rem (total body) and that milling contributes about 100 person-rem (total body) of a total of about 610 person-rem (total body) to offsite U.S. population per annual fuel requirement.

[6] Liquid radiological effluents from reprocessing and waste management activities in the fuel cycle contribute 1.4×10^{-4} person-rem (total body) to offsite U.S. population per annual fuel requirement or reference reactor year. For comparison all radiological liquid effluents from fuel cycle operations contribute about 100 person-rem (total body) to offsite U.S. population per annual fuel requirement or reference reactor year. This dose is <0.0005 percent of the average natural background radiation dose to this population.

Title 10—Energy

CHAPTER I—NUCLEAR REGULATORY COMMISSION

PART 51—LICENSING AND REGULATORY POLICY AND PROCEDURES FOR ENVIRONMENTAL PROTECTION

Uranium Fuel Cycle Impacts From Spent Fuel Reprocessing and Radioactive Waste Management

AGENCY: Nuclear Regulatory Commission.

ACTION: Effective clarifying amendment to Tables S-3 and Response to Petition for Rulemaking filed on behalf of the New England Coalition on Nuclear Pollution (Docket No PRM-51-1).

SUMMARY: The Commission has previously published Table S-3 of 10 CFR Part 51 which identified environmental effects for the uranium fuel cycle which are to be included in environmental reports and environmental impact statements for individual light water nuclear power reactors. This action amends the prior regulations to remove the value contained in Table S-3 for releases of radon and to clarify that Table S-3 does not include health effects from the effluents described. The rule as amended states that the fuel cycle rule does not preclude consideration of these impacts in individual cases. This action also responds to the NECNP rulemaking petition.

EFFECTIVE DATE: April 14, 1978.

FOR FURTHER INFORMATION CONTACT:

Ms. Jane A. Axelrad, Office of the Executive Legal Director, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555, phone: 301-492-7437.

SUPPLEMENTARY INFORMATION: Notice is hereby given that the Nuclear Regulatory Commission (hereinafter "NRC" or "Commission") has decided to amend

Table S-3 of 10 CFR Part 51 "Summary of Environmental Considerations for Uranium Fuel Cycle" in the Commission's regulations "Licensing and Regulatory Policy and Procedures for Environmental Protection," 10 CFR Part 51. Specifically, the Commission has decided to clarify that certain environmental effects from the uranium fuel cycle are not included in the Table and may be litigated in individual cases.

In conjunction with this notice of rulemaking, the Commission hereby gives notice that the petition for rulemaking submitted by letter dated November 19, 1975 by Roisman, Kessler, and Cashdan, 1025 15th Street, N.W., Washington, D.C., on behalf of the New England Coalition on Nuclear Pollution is being denied in part. However, the issues raised in the petition relating to Radon-222 will be addressed in a future ratemaking proceeding to amend the value for Radon in Table S-3. Accordingly, action on this part of the petition is being deferred.

Description of the Petition

The New England Coalition on Nuclear Pollution petitioned the Commission to amend Table S-3 of 10 CFR Part 51, "Summary of Environmental Considerations for Uranium Fuel Cycle" in the Commission's regulations "Licensing and Regulatory Policy and Procedures for Environmental Protection," 10 CFR Part 51. A notice of the filing of the petition, Docket No. PRM-51-1, was published in the Federal Register on January 16 1976 (41 FR 2448).

The petition for rulemaking was accompanied by two technical documents authored by Professor Robert O. Pohl, Professor of Physics, Cornell University, entitled "Nuclear Energy: Health Impact of Carbon-14" and "Health Effects of Thorium-230." These technical papers provided the technical bases for the claims presented in the petition. On December 23, 1976, the NRC received a final draft of Professor Pohl's paper "Nuclear Energy: Health

Impact of Carbon-14" that replaced the draft previously sent to the NRC on November 19, 1975 as part of the original petition.

The notice of petition filing invited interested persons to submit written comments or suggestions on the petition by March 16, 1976. Because of public interest about the concerns expressed by the petition, the public comment period was extended to April 26, 1976 (41 FR 12365). The following responded to the requests for written comments: Atomic Industrial Forum, Inc.; Commonwealth Edison Co.; U.S. Environmental Protection Agency (EPA); General Electric Co.; Nuclear Fuel Services, Inc.; Ranchers Exploration and Development Corp.; Tennessee Valley Authority; Union Carbide Corp.; United Nuclear Corp.; and Westinghouse Electric Corp. All commentors except EPA, recommended that NRC should deny the petition because, in their opinion, the petitioners have provided insufficient bases and rationale to support their claims for reassessing Table S-3 and existing licenses and for the postponement of pending applications. EPA only supplied correspondence between EPA and Dr. Pohl because of references made in the petition to EPA's dose estimate methods presented in the EPA Uranium Fuel Cycle report, EPA-520/9-73-003-B, October 1973.

In the petition, the petitioners state that: (1) The current Table S-3 seriously underestimates the impact on human health and safety by disregarding the long-term effects of certain long-lived radionuclides, particularly Thorium-230 which decays into radon gas, and that the health effects of uranium mining and milling, presently listed in Table S-3 as a total of 0.06 man-rems within five miles of the plant per annual fuel requirement, fails to disclose the long-term and long-range health effects of radon-222 gas released from tailings piles; (2) The health effects of Krypton-85 and Tritium releases from fuel reprocessing plants are underestimated in Table S-3; (3) Releases of Carbon-14 from the fuel cycle should be in-

cluded in Table S-3; (4) That Table S-3, by the exclusive use of the term "man-rems", does not provide a meaningful representation of these health effects, at least in the case of those radionuclides involved in this petition, and that human deaths from man-rem exposures provide a more easily comprehended consequence of the fuel cycle activities; and (5) The magnitude of the potential death toll from mill tailings alone is so great as to alter the previous judgments on these matters and to require as a minimum a reassessment of previous conclusions to authorize construction or operation of nuclear reactors and a postponement of resolution of all pending applications for construction or operation authority until final resolution of this issue by the Commission.

The petitioners requested certain numerical changes and additions as well as a narrative text to be incorporated into Table S-3 of 10 CFR Part 51 under the subheading entitled "Effluents—Radiological (curies), Gases (including entrainment)."

DISPOSITION OF ISSUES RAISED IN THE PETITION

With regard to the first issue raised by the petition, the current Table S-3 value for Radon-222 is incorrect and does not include:

Estimates of radon released from mining operations.

Estimates of releases of radon from interim tailings piles after the mill has shut down and during the ensuing period while the tailings pond is evaporating and before stabilization programs are completed.

Estimates of releases of radon from stabilized mill tailings piles.

At the time the Staff developed the Table S-3 value for radon, the Staff did not have sufficient data to quantify the releases from radon involved in the mining of uranium. The Staff was unable to find any field data for radon emissions, but field measurements taken by the

Bureau of Mines for radon concentrations in open pit mines revealed no significant alpha concentrations.

Even though there was no meaningful field data for estimating a specific radon release quantity, the Staff was able to conclude that radon concentrations away from the immediate vicinity of the mine would not be detectable against natural background. This Staff conclusion was supported by conclusions reached in the BEIR report[1] and the U.S. Environmental Protection Agency report, "Estimates of Ionizing Radiation Doses in the United States 1960-2000,"[2] both of which are cited in WASH-1248.

With regard to milling, estimates of releases from interim tailings piles were not included because it was assumed that these piles remained wet until stabilized and therefore did not permit significant releases of radon. The Staff considered available information, particularly the report of the U.S. Environmental Protection Agency entitled, "Estimates of Ionizing Radiation Doses in the United States 1960-2000" to determine releases from stabilized piles. This document reported the results of studies made at active and inactive mill sites with covered and uncovered tailings which showed no significant radiation exposure to the public. Based on these studies, the Staff concluded in WASH-1248, B-23, that population doses attributable to the uranium milling industry would not be distinguishable from natural background radiation.

However, since the original Table S-3 was promulgated, new estimates of releases have been devised that require

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[1] "The Effects on Populations of Exposure to Low Levels of Ionizing Radiation," Report of the Advisory Committee on the Biological Effects of Ionizing Radiation (BEIR), Nat'l. Ac. Sci., Nat'l Res. Council, Washington, D.C., (Nov. 1972), P. 15 (Cited in WASH-1248 at p. A-4).

[2] ORP/CSD 72-1, Estimates of Ionizing Radiation Doses in the United States 1960-2000, U.S. Env. Prot. Agency (Aug. 1972), p. 27. (Cited in WASH-1248 at p. A-4).

upward revision of the value for radon in Table S-3. Therefore, the Commission is amending Table S-3 to eliminate the value for radon releases. This issue may henceforth be litigated in individual licensing proceedings since it is not now covered by the rule. A clarifying amendment to Table S-3 to this effect is set forth below.

The Commission intends to evaluate data that is being collected in a series of ongoing programs described below and will determine when the Generic Environmental Impact Statement (GEIS) on uranium milling is issued whether to initiate a limited rulemaking proceeding to include a revised value for Radon-222 in an updated Table S-3. In determining whether to initiate such a rulemaking, the Commission will evaluate the arguments of the NECNP petition. It will also consider statements made in a memorandum written by Walter H. Jordan, a member of the Atomic Safety and Licensing Board Panel, to James R. Yore, Chairman of the Atomic Safety and Licensing Board Panel. A copy of that memorandum, which raised issues similar to those raised in the petition, is on file in the NRC public document room. In any event, the Commission plans a general long-term effort to update the rule and the radon issue will be addressed then.

The second and third issues raised by the petition were specifically addressed when the Commission published a revised interim Table S-3 in March of 1977 (42 FR 13803, March 14, 1977). Interim Table S-3 contains upward revisions of releases for both Krypton-85 and Tritium. The differences between the petitioner's estimates of releases and the NRC estimates are due to differences in the models. The basis for the NRC models is described in detail in NUREG-0116 and 0216.

Carbon-14 has been added to the interim Table S-3. The differences between petitioner's estimates of releases and the NRC estimates are due to differences in models. The basis for the Carbon-14 model is described in NUREG-0116 and NUREG-0216.

The petitioner's fourth issue is that Table S-3 does not provide a meaningful representation of health effects. Health effects were addressed in NUREG-0216 in response to comments that the Commission should have considered them. However, the Commission decided to pattern the interim rule after the original S-3 Table which did not include such effects in the actual table. The Commission implicitly addressed fuel cycle health effects in the Statement of Consideration accompanying Table S-3 when the Commission noted that "the environmental impacts of the uranium fuel cycle have been shown to be relatively insignificant."[8] Accordingly, health effects were not discussed in individual licensing proceedings until after the decision in *Tennessee Valley Authority* (Hartsville Nuclear Plant, Units 1A, 2A, 1B, and 2B), 5 NRC 92, 103 (1977) where the Appeal Board required that they be considered in connection with comparison of the uranium and fossile fuel cycles. The Commission believes that, for the present, the purposes of NEPA are advanced by discussing health effects in individual cases. To clarify this point, the Commission has removed all dose estimates attributable to gaseous effluents from the Footnotes in the Table and has amended Footnote 1 to indicate that health effects are not covered by the Table and may be litigated in individual cases.

To summarize the Commission's position on the NECNP petition:

1. The portion of the petition that recommends that Table S-3 be amended to include upward revisions of the values for Krypton-85, Tritium and Carbon-14 was in effect granted, although the specific values suggested by the petitioner were not adopted. These values were revised upward when the Commission promulgated the Interim Table S-3 on March 14, 1977 and are being reexamined during the final rulemaking proceeding on waste management and reprocessing.

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[8] 39 FR 14188.

2. The portion of the petition that recommends that Table S-3 be amended to include health effects is denied. The Commission has determined for the present that these effects should be dealt with in individual licensing proceedings rather than by rule. The effluent release data set forth in the revised Table shall provide the basis for derivation of population doses and resultant health effects in individual licensing proceedings. The Commission will, at a later date, reexamine whether doses and health effects should be included in Table S-3. It will also address the question of what period of time should be used to calculate doses and health effects. These issues have been raised in the final rulemaking proceeding on waste management and reprocessing mentioned above and will be addressed in the overall revision of Table S-3 described below.

3. The Commission agrees with that portion of the petition that recommends that the values for Radon-222 in Table S-3 be amended. The Commission, however, is deferring instituting a rulemaking on this issue. The Commission recognizes that radon releases from the fuel cycle must be considered in licensing decisions. Pending generic consideration of this issue, radon released from the fuel cycle can be considered in individual proceedings.

Petitioner has asserted that the NRC should halt licensing until the issues raised by the petition are resolved. The Commission believes that the clarifying amendment now issued removes any need for a blanket postponement of licensing. Some issues raised by the petition have already been resolved by the Commission. Other issues, particularly those relating to Radon-222 and health effects, may be considered in individual cases. The Commission believes that the information that is presently available should enable individual licensing boards to evaluate the significance of fuel cycle radon releases in striking the environmental cost-benefit balance for a nuclear power

reactor.[4] The Commission has chosen to leave these issues open for litigation in individual proceedings, rather than freeze by an immediate rulemaking the form such an evaluation should take, in order that experience with varying approaches may be gathered as a possible basis for generic rule later on. Also, much new information relevant to the environmental impacts of radon will soon become available. When the Commission considers environmental impacts in individual licensing actions, it need not also consider them generically. *NRDC v. NRC*, 547 F.2d 633, 641 (D.C. Cir. 1976) *cert.* granted 429 U.S. 1090 (1977) (No. 76-419). Accordingly, the Commission denies petitioner's request to halt licensing of reactors.

The Commission does not believe it is necessary to now reopen all proceedings where licenses have already been issued. With regard to the most serious issue, radon releases, as discussed below, a number of programs are in progress to gather additional information on the environmental impacts of mining and milling. Upon completition of these programs, the Commission may reassess its conclusions as to the acceptability of the environmental impacts from mining and milling. Existing licenses may be reevaluated at that time if the data warrants it. It does not seem likely that any radon hazard associated with continued construction or continued operation of reactors in the interim will be significant. The short term releases of radon from mill tailings will be small, and steps can be taken in the future to reduce long-term releases.[5]

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[4] It remains up to the licensing board, however, to determine in the first instance whether the evidence actually presented to it by the parties and the NRC staff is sufficient to support an environmental analysis that meets NEPA standards.

[5] The NRC Staff is currently requiring applicants for uranium mill licenses to commit to plans for tailings disposal in accordance with interim criteria developed by the Staff for tailings waste management and disposal. Key features of these interim criteria include requirements to (a) locate the tailings in an area such that disruption and dispersion by natural forces are minimized, (b) re-

If, however, anyone believes that the circumstances of a particular case dictate that a license should be reexamined to take into account new information on radon or on the other subjects on which the amendments set forth below would now permit case-by-case adjudication, then an appropriate request for enforcement action can be filed under 10 CFR § 2.206.

Where limited work authorizations, construction permits, or operating licenses have been issued but proceedings are still pending before Licensing or Appeal Boards, evidence on radon releases shall be received as follows:

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duce the release of radon from the tailings disposal area to about twice the release rate in the surrounding environs, and (c) eliminate the need for routine long-term monitoring and maintenance programs.

Licensees have proposed various methods to meet the performance objectives. One is a surface burial method whereby radon control and isolation is achieved through placement of a clay cap over the tailings covered by an overburden of several feet of soil with appropriate consideration given to minimizing effects of wind and soil erosion.

A more recent method that has been proposed consists of below grade burial of the tailings to provide increased assurance that tailings will remain isolated for long periods of time. This kind of disposal virtually eliminates potential for disturbance by natural erosion forces and makes possible increased attenuation of radon releases. Return of the tailings to open minepits has been selected as the tailings disposal method for one of our applicants. Below grade disposal is being evaluated as the prime option for other mills currently undergoing license review.

The generic environmental impact statement on uranium milling presently being prepared by the Commission is considering a wide range of alternatives similar to those previously evaluated by Oak Ridge National Laboratory (ORNL-4903). For example, it will evaluate alternatives which entail removing radioactivity from the tailings.

On the basis of the Staff's reviews of reclamation plans employing surface burial or below grade burial methods, the Staff has advised the Commission that steps such as those described above, can be taken in the future to reduce long-term releases from tailings disposal sites.

In proceedings pending before Licensing Boards, the Commission hereby directs the Licensing Boards to reopen the record on NEPA issues for the limited purpose of receiving new evidence on radon releases and on health effects resulting from radon releases. Where cases are pending before Appeal Boards, the Appeal Boards are also directed to reopen the records to receive new evidence on radon releases and on health effects resulting from radon releases.

LWA's, construction permits, or operating licenses already issued shall remain effective unless a stay of the decision issuing the license or LWA is granted upon request of a party pursuant to the criteria set forth in 10 CFR § 2.788.

ONGOING PROGRAMS

The Commission has a number of programs in progress, some of which will supply data necessary for a generic resolution of issues not now covered in Table S-3:

Waste management and reprocessing. The Commission recently published a revised interim Table S-3 (42 FR 13803, March 14, 1977) along with supporting documents, NUREG-0116 and NUREG-0216. The Commission has already begun to conduct rulemaking proceedings to replace the interim Table S-3 with an updated rule in the areas of fuel reprocessing and waste management.[6]

Milling. Preparation of a draft Generic Environmental Statement (GEIS) on mill tailings is underway and is expected to be made available for public comment in September 1978. In conjunction with preparation of this statement, an extensive multiyear field measurement program was initiated in early 1977 to develop data to estimate effluent release rates from mills and stacks, from ore piles and from tailings piles. These studies will also

[6] Nothing in this Notice should be construed as affecting in any way the scope of the final rulemaking proceeding on waste management and reprocessing.

measure offsite concentrations to evaluate transport information and the significance of food ingestion pathways. Specific laboratory studies are also being conducted to estimate radon emissions from tailings piles both during operation and following stabilization. More recently, a general study was initiated as part of the GEIS to evaluate the long term stability of mill tailings disposal alternatives. Data from these studies is expected to become available in the summer of 1978. As a result of these studies the Commission will evaluate whether levels of radon releases should be further reduced.

The Commission will explore several alternatives to determine what level of reduction of releases is environmentally acceptable including reduction of radon releases to natural background levels and reduction of releases to amounts equal to releases had no mining or milling taken place.

Mining. A 2-year research program was initiated in the fall of 1977 to obtain measurements of radon-222 at underground and open pit mines. The initial measurements from underground mines are expected early in 1978. Information from this program and from research on uranium mills might provide a basis for the limited rulemaking proceeding on radon described above. As was stated previously, the Commission will make the determination whether to initiate such a limited proceeding after the draft GEIS on milling is issued.

Overall update of Table S-3. In addition to the aforementioned programs, the Commission has announced its intention to initiate a long-term effort to completely update the rule in all areas of the fuel cycle. (42 FR 26987, May 26, 1977). Specific efforts to produce a completely updated and revised Table S-3 and supporting document for the entire fuel cycle have begun. A technical assistance contractor to work with the NRC staff is now being selected. The contractor will first analyze the format and content of Table S-3 to determine the method for most

effectively characterizing environmental impacts. The contractor will collect, evaluate, and synthesize the results from a wide range of applicable NRC research and study programs. The major research programs include field measurements of radon releases from mining and the GEIS on milling, as discussed above. In addition, emphasis will be given to NRC studies of occupational exposure, decommissioning, and non-radiological effluents. The importance of new concepts and technologies, such as centrifuge enrichment, mining by in-situ leaching, spent fuel storage, and disposal will be evaluated.

IMMEDIATE CLARIFYING CHANGES

The amendments to Table S-3 set forth below clarify that the Table does not cover:

Estimates of radon released;

Health effects.

Accordingly, pursuant to the Atomic Energy Act of 1954, as amended, the Energy Reorganization Act of 1974, as amended, the National Environmental Policy Act of 1969, as amended, and section 553 of Title 5 of the United States Code, the following amendments to 10 CFR Part 51 are published as a document subject to codification. Since the amendments are of a clarifying nature, serve to relieve a restriction, and are necessary to enable correct information regarding fuel cycle environmental impacts to be utilized in ongoing and future licensing proceedings, the Commission has found that good cause exists for omitting notice of proposed rulemaking and public procedure thereon, and that the amendments may be made effective upon publication.

In Table S-3—Summary of environmental considerations for uranium fuel cycle, of 10 CFR Part 51, (a) the entry for Radon-222 under "Effluents—radiological (curries [*sic*])" and the accompanying textual material which now reads:

"Rn-222.....	74.5	Principally from milling operations and excludes contributions from mining."

is revised to read as follows:

"Rn-222.....	—	Presently under reconsideration by the Commission."

and (b) footnotes 5 and 6 accompanying the Table are deleted and footnote 1 is amended to read as follows:

"[1] In some cases where no entry appears it is clear from the background documents that the matter was addressed and that, in effect, the Table should be read as if a specific zero entry had been made. However, there are other areas that are not addressed at all in the Table. Table S-3 does not include health effects from the effluents described in the Table, or estimates of releases of Radon-222 from the uranium fuel cycle. These issues which are not addressed at all by the Table may be the subject of litigation in individual licensing proceedings. Data supporting this Table are given in the 'Environmental Survey of the Uranium Fuel Cycle,' WASH-1248, April 1974; the 'Environmental Survey of the Reprocessing and Waste Management Portions of the LWR Fuel Cycle,' NUREG-0116 (Supp. 1 to WASH-1248); and the 'Discussion of Comments Regarding the Environmental Survey of the Reprocessing and Waste Management Portions of the LWR Fuel Cycle,' NUREG-0216 (Supp. 2 to WASH-1248). The contributions from reprocessing, waste management and transportation of wastes are maximized for either of the 2 fuel cycles (uranium only and no-recycle). The contribution from transportation excludes transportation of cold fuel to reactor and of irradiated fuel and radioactive wastes from a reactor which are considered in Table S-4 of sec. 51.20(g). The contributions from the other steps of the fuel cycle are given in columns A-E of Table S-3A of WASH-1248."

3. The second sentence of 10 CFR § 51.20(e) is amended to read as follows:

"No further discussion of the environmental effects addressed by the Table shall be required."

Effective date: The foregoing amendments take effect on April 14, 1978.
(Sec. 102, Pub. L. 91-190, 83 Stat. 853, as amended, Pub. L. 94-83, 89 Stat. 424 (42 U.S.C. 4332); Sec. 161, as amended, Pub. L. 83-703, 68 Stat. 948 (42 U.S.C. 2201); Sec. 202, Pub. L. 93-438, 88 Stat. 1244 (42 U.S.C. 5842); Pub. L. 89-554, 80 Stat. 383 (5 U.S.C. 553).)

Copies of the petition for rulemaking, the associated public comments, and the Commission's letter to the petitioner are available for inspection or publication in the Commission's Public Document Room at 1717 H Street, NW., Washington, D.C. 20555.

Dated at Washington, D.C. this 11th day of April, 1978.

For the Nuclear Regulatory Commission.

SAMUEL J. CHILK,
Secretary of the Commission.

[FR Doc. 78-9952 Filed 4-13-78; 8:45 am]

[SEAL]

UNITED STATES
NUCLEAR REGULATORY COMMISSION
Washington, D.C. 20555

October 26, 1978

MEMORANDUM FOR: Samuel J. Chilk, Secretary

FROM: Fuel Cycle Rulemaking Hearing Board
Michael L. Glaser
Dr. John H. Buck
R. Beecher Briggs

SUBJECT: Conclusions and Recommendations of the Hearing Board Regarding the Environmental Effects of the Uranium Fuel Cycle, Docket No. RM 50-3

The Hearing Board has completed its conclusions and recommendations regarding the environmental effects of the uranium fuel cycle, Docket No. RM 50-3. Accordingly, we are submitting them to the Commission as an attachment to this memorandum.

We wish to call to the attention of the Commission the additional comments we have made with respect to the record in this reopened rulemaking proceeding. Such comments are set forth in section IV of the attachment, at pages

FUEL CYCLE RULEMAKING
HEARING BOARD

/s/ Michael L. Glaser
MICHAEL L. GLASER

/s/ John H. Buck
JOHN H. BUCK

/s/ R. Beecher Briggs
R. BEECHER BRIGGS

Attachment

cc: Chairman Hendrie
Commissioner Gilinsky
Commissioner Kennedy
Commissioner Bradford
Commissioner Ahearne

CONCLUSIONS AND RECOMMENDATIONS OF THE HEARING BOARD REGARDING THE ENVIRONMENTAL EFFECTS OF THE URANIUM FUEL CYCLE DOCKET NO. RM 50-3

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I. *Introduction*

The history of this rulemaking proceeding has already been discussed extensively by the Commission in its Notice of Reopened Hearing [1] and in our recent Report to the Commission [2] so that we need not repeat it here. It is sufficient to say that judicial review [3] of the original fuel cycle rule (the so-called Table S-3) while approving the overall approach and methodology leading to its adoption "found that the rule was inadequately supported by the record insofar as it treated two particular aspects of the fuel cycle—the impacts from reprocessing spent fuel and the impacts of radioactive waste management".[4] The Commission's response to the court's decision resulting in this rulemaking hearing has been fully discussed in our Report to the Commission (pp. 7-16).

Based on the record of this reopened proceeding to date, we now present our recommendations for modification of the present Table S-3. We emphasize that our findings and recommendations must be read in light of our discussion of the staff's models and assumptions in our Report previously submitted to the Commission (see fn. 2, *supra*).

We note that in reaching its conclusions on the environmental impacts from reprocessing and waste management the staff utilized a number of models of facilities and systems for reprocessing and waste disposal. The staff included in these models assumptions of time factors for certain steps in the processes and choices of method-

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[1] Notice of Reopened Hearing in the Matter of Amendment of 10 CFR Part 51—Licensing of Production and Utilization Facilities (Environmental Effects of the Uranium Fuel Cycle) dated May 20, 1977.

[2] Report of the Hearing Board to the Nuclear Regulatory Commission Regarding the Environmental Effects of the Uranium Fuel Cycle, Docket No. RM 50-3, August 31, 1978.

[3] *Natural Resources Defense Council, Inc.* v. *NRC*, 547 F.2d 633.

[4] Commission Notice of Reopened Hearing, May 20, 1977 at p. 2.

ology based on its understanding of current technologies. We will first discuss whether the staff's models for reprocessing and waste management are reasonable and then give our recommendations for modifications in Table S-3.

II. *Board Findings on Staff Models*

In our consideration of the staff's models we have been guided by the following statements of the Court, made in its judicial review of the original fuel cycle proceeding:

> NEPA's requirements for forecasting environmental consequences far into the future implies the need for predictions based on existing technology and those developments which can be extrapolated from it. *NRDC* v. *NRC*, *supra*, n. 3, 547 F.2d at 639-40.
>
> Where important changes in the state of the art or other major uncertainties are in the offing, meaningful assessments of future environmental impacts might be facilitated by making two alternative estimates: one based only on existing technology and another which takes into account developments which may reasonably be anticipated. *Id.* at 640, fn. 13.
>
> Finally, we reject the related argument that plenary consideration of alternatives was necessary in this proceeding. We agree with the Commission that this may be deferred until action is proposed to license particular disposal facilities. For purposes of this proceeding, provided a sufficiently conservative and credible assessment of a particular waste disposal method is used, it is not material that another method might turn out to be even more desirable. * * * Of course, we do not exclude the possibility that limited consideration of certain alternatives (*e.g.*, the consequences of not proceeding at all) may be necessary to meaningful judgments in a proceeding such as the present. *Id.* at 653, fn. 57.

A. *Reprocessing* [5]

For the reprocessing alternative, the staff assumes that the spent fuel, after 150 days cooling at the reactor, will be shipped to a model reprocessing facility. In the model facility the fuel elements will be sheared into small pieces, and the uranium, plutonium and fission products will be dissolved in nitric acid leaving behind the cladding hulls and hardware. The uranium, plutonium and fission products will then be separated into three liquid fractions by the Purex solvent extraction process. The uranium will be converted to uranium hexafluoride that satisfies the purity requirements for recycling in an enrichment plant. The plutonium, containing about five percent of the fission products in order to make diversion more difficult, will be converted to plutonium oxide and packaged for disposal in a Federal repository.

The high level liquid waste (HLLW), containing the bulk of the fission products, will be stored for up to five years in tanks. Such wastes will then be calcined to a solid and formed into massive glass in a spray-calciner and in-can melter for disposal.

Most of the other radioactive wastes at the reprocessing site will be contaminated with plutonium and other transuranium (TRU) nuclides to the extent that they will have to be disposed of in a Federal repository. The combustible wastes will be incinerated. Incinerator ash, other dispersible solids, and aqueous concentrates will be mixed with cement or other solidification agents and packaged. Cladding hulls, hardware and other noncombustible solid wastes will be appropriately packaged for disposal.

Our review of the record indicates that no significant issues were raised regarding the staff's choice of processes

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[5] As noted on page 4, *supra*, our discussion here must be read in conjunction with our previous Report to the Commission (see fn. 2, *supra*) and detailed references given in that discussion are not repeated here.

in its model for the reprocessing. While some of the participants in this proceeding would have selected different processes or equipment, none actually contended that the staff's choices were impractical. Substantial issues were raised concerning whether the staff had made a conservative analysis of the performance of its model reprocessing facility; whether the capacity and capacity factor of the model are warranted; whether the radioactive releases and occupational exposures are conservative; and whether reprocessing is economically feasible.

1. Design Capacity of Model Reprocessing Facility

The staff's model facility is specified to have the capacity to reprocess 2000 MTHM/yr [6] when operating with a capacity factor of 0.8. The staff assumed that such a facility would reprocess spent fuel from 57 model reactors. Each model reactor was specified to have a capacity of 1000 MWe, to have a capacity factor of 0.8 and to discharge 35 MT/yr of spent fuel with a burnup of 33,000 MWD/MT.

Although the only commercial experience in this country with reprocessing of spent uranium oxide fuel from LWR's was obtained from the 300 MT/yr (1 MT/day) Nuclear Fuel Services (NFS) plant, the Barnwell plant (Allied Gulf Nuclear Services) has been built with a capacity of 1500 MT/yr (5 MT/day). Exxon Nuclear has applied for a permit to construct the Nuclear Fuel Recovery and Recycling Center (NFRRC) designed for an ultimate capacity of 2100 MT/yr (7 MT/day). The United States Government plants at Hanford and Savannah River, which reprocess low burnup uranium metal fuels by use of the Purex method, have capacities of 14 to 30 MT/day.

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[6] MTHM = metric tons of heavy metal (uranium and plutonium), MTU = metric ton of uranium, and MT = metric ton are assumed to be equivalent terms in this discussion.

According to the staff, the model facility is intended to be representative of plants built after Barnwell. Three model facilities, in addition to Barnwell and NFRRC, would be required to reprocess the fuel from the 268 LWR's expected to be operating or under construction in the early 1980's. In view of the industry's trend toward larger plants, the fact that much of the technology is in use on a larger scale in the United States government plants, the potential supply of spent fuel, and other factors in the record before us, we find that 7 MT/day is a reasonable choice of capacity for the staff's model facility.

2. Components of the Reprocessing System

Some of the components and systems included in the model facility have not been operated in a radioactive environment on a 7 MT/day scale. Foremost among these are the head-end process consisting of a shear and dissolver, the centrifugal contactor in the first stage of the Purex process, the facility for converting fission-product-contaminated plutonium nitrate into plutonium oxide, the incinerator for combustible TRU waste, and the process for solidifying HLW.

a. Shearing

A shear and dissolver in the NFS facility operated at the plant design capacity of 1 MT/day for extended periods. However, difficulties with the head-end process, mostly with the shear and maintenance of the shear, was one of the major reasons for the capacity factor of the NFS plant being only 0.33 as compared with the expected 0.8. A shear and dissolver system having a capacity of 5 MT/day has been installed at Barnwell. The shear is reported to have operated well in cold (non-radioactive) tests. Improvements in the design and in the equipment for maintenance, intended to overcome the difficulties ex-

perienced at NFS, have been incorporated in Barnwell.[7] A shear of similar capacity is being developed for the NFRRC. Moreover, special attention is being given to maintenance. Two shears are included in the design to enable the plant to reprocess at a rate of 7 MT/day. A program for developing an improved shear and maintenance system is beginning at the Oak Ridge National Laboratory under the sponsorship of the Department of Energy.

Clearly, the solutions to the problems of shearing fuel elements experienced at NFS have not yet been demonstrated. However, the record here indicates that the head-end processing at Barnwell and NFRRC will be much improved over that at NFS. Use of two or more units per plant may be necessary to obtain a capacity of 7 MT/day and an adequate capacity factor, but nothing offered in the record suggests that the problems are so unique or difficult that they will not yield to good engineering and additional experience.

b. Centrifugal Contractors

Centrifugal contractors have been used in France and at Savannah River with good results. If the reliability of centrifugal contractors should prove to be inadequate, conventional pulse columns could be substituted. However, in order to reduce the degradation of the organic solvent, such a change might require that, before reprocessing, the spent fuel decay more than the 160 days assumed by the staff. Decay time before reprocessing is discussed at pp. 17-18, *infra*.

c. Conversion of Plutonium Nitrate

Processes for converting plutonium nitrate, highly decontaminated of fission products, to plutonium oxide and

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[7] A similar shear has been used recently to shear oxide fuel elements for reprocessing in the La Hague plant in France. Apparently, difficulties have been experienced with maintenance of that shear, but it is not known how the provisions for maintenance compare with those installed at Barnwell.

for handling the oxide in glove boxes are well developed. Leaving the plutonium highly contaminated with fission products to discourage theft means that these operations will have to be carried out remotely in hot cells. Although such a change is not trivial, the extensive experience with hot cell operations should make such a change achievable with moderate development. If the development should prove to be unexpectedly difficult, highly purified plutonium nitrate might be converted to the oxide and other means used to prevent theft or to contaminate the plutonium oxide just before it is packaged.

d. Incinerators

There is little question that incinerators can be built and operated on the scale required for a 7 MT/day reprocessing facility. Whether such a unit can be operated and maintained satisfactorily to burn waste containing TRU and fission product nuclides is in the process of being demonstrated. The staff chose this process over others for the model facility because it reduces the volume, removes combustible material from waste to be sent to a geologic repository, and it is conservative in that it produces higher environmental impacts than would be produced by other possible alternatives. If this method proves to be impractical, there are alternative methods for handling the waste and for reducing concerns about flamability.

e. Solidification of High Level Wastes (HLW)

Although to the present no HLW from the reprocessing of LWR spent fuel has been solidified, the spray-calciner in-can melter process has been extensively developed over many years. The development has included the processing on a 1 MT/day scale of simulated waste containing representative levels of fission product heat generation. The process has been tested with non-radioactive simulated waste on a 9 MT/day scale in a recently completed

engineering test apparatus. The results of this program give ample reason to conclude that the development can be completed to provide satisfactory equipment and process for the model facility.

We find that equipment is presently available or can reasonably be expected to be developed for operating a facility of 2000 MT/yr capacity. We now consider whether the 0.8 plant factor is reasonable or necessary and the effect on the environmental impacts if that plant factor were not achieved.

3. Facility Capacity Factor

The NFS plant operated with a capacity factor of only 0.33. The United States Government plants are reported to operate with a downtime of 20 to 25 percent which implies a capacity factor of 0.75 to 0.8. Because of improvements incorporated in Barnwell and the fact that Barnwell will reprocess only LWR fuels, we find reason to conclude that the capacity factor at Barnwell will be substantially higher than at NFS. Unquestionably problems will be encountered and it may take some time to achieve satisfactory operation. We also assume that no administrative barriers to high capacity factors will be imposed.[8] However, we believe it reasonable to expect that a model facility, following Barnwell and taking advantage of lessons learned there, would achieve a still higher capacity factor. Nonetheless, we find no precedent in experience with fuel reprocessing facilities to support an assumption that the capacity factor would actually be as great as 0.8 over the 30-year life of a facility.

For the purpose of Table S-3, the important assumption is that a model facility will reprocess fuel from 57

[8] One such barrier, suggested by one of the participants in this proceeding would be to require that operation be interrupted in order to establish a plutonium balance for each batch of reprocessed fuel (~ 35 tons). (Testimony of Pohl and Resnikoff, Appendix A, pp. 146-147.)

model reactors. The annual impacts of operation of the reprocessing facility are divided by 57 to obtain the annual impact attributed to each reactor in the Table. The record shows that the staff was conservative in assuming that the model reactor would discharge 35 MT/yr of spent fuel with a burnup of 33,000 MWD/MT. A realistic discharge rate would be about 30 MT/yr with a burnup of 31,000 MWD/MT or 29 MT/yr if the burnup were 33,000 MWD/MT.[9] A model reprocessing facility operating with a capacity factor of 0.7 could reprocess the spent fuel discharged at these rates from 57 model reactors.

We find an adequate basis in the experience with government plants for assuming that commercial reprocessing facilities following Barnwell will be able to achieve capacity factors as high as 0.7. We find, therefore, that the staff's model facility would be able to reprocess spent fuel from 57 reactors. The staff has also used a reasonable basis for estimating those impacts such as land committed which depend on plant size. By assuming that the model facility would have to operate with a capacity factor of 0.8 (35 MT/RRY) the staff has used a basis that should result in overestimates of impacts such as consumption of water and energy and releases of chemical effluents all of which depend primarily on the amount of spent fuel reprocessed per RRY.[10]

If it developed that the reprocessing facilities were unable to achieve a capacity factor as high as 0.7 some of the impacts (primarily those determined by size and number of facilities) would increase. However, except for the releases of radioactivity, most of the impacts of reprocessing are only a small fraction of the total values of environmental impacts in Table S-3. Large changes

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[9] See our Summary Report, p. 28.

[10] RRY—Operation of the Reference (or Model) Reactor for one year.

in capacity factor or plant size would not have much effect on the total impact values in Table S-3.[11]

The Board finds that the capacity and capacity factor of the staff's model facility provide a reasonable basis for its analysis of the environmental impacts of spent fuel reprocessing. No participant here has taken issue with the staff's values for natural resources used, chemical effluents, or thermal effluents. We find that the impact values are reasonable and in most instances are overestimates of the impacts that would actually occur.

4. Staff's Values for Releases of Radioactive Nuclides

The record shows that several factors in the staff's analysis of radioactive releases tend to cause the results to be overestimates of the releases that would actually occur.

a. Level of Fuel Burnup

Assuming the reprocessing of 35 MT/RRY with a burnup of 33,000 MWD/MT rather than the realistic value of 30 MT/RRY with a burnup of 31,000 MWD/MT causes the releases to be overestimated by a factor of 1.2.

b. Time to Start of Reprocessing

The staff assumed that the spent fuel would be reprocessed after 160 days decay. Considering the rate at

[11] Only in the cases of land temporarily committed, amount of natural gas consumed, and releases of radioactivity in gaseous effluents do the impacts of fuel reprocessing constitute as much as 10 percent of the total impact values in Table S-3. The values for land temporarily committed for reprocessing is about one-third of the total only because it was not prorated over the life of the facility as it was for other components of the fuel cycle. The consumption of natural gas and release of radioactivity are governed primarily by the quantity of spent fuel reprocessed per RRY and should not be much affected by plant size or capacity factor.

which spent fuel will be accumulated and the time when reprocessing plants are likely to be operating, it is obvious that for many years to come the spent fuel will decay for five years or more before being reprocessed. This is unimportant for nuclides having long half lives, but iodine-131 (8-day half life) would have decayed away, ruthenium-106 (368-day) would be reduced by a factor of about 30, and tritium and krypton-85 would be reduced by a factor of 1.3 or more. Overall the longer decay would reduce the number of curies of radioactivity and the heat from the radioactive decay by a factor of about 8.

c. Reprocessing Plants Effluents

All the radioactivity released to the environment from the reprocessing facility will be in gaseous effluents. The gas streams which would be expected to contain appreciable amounts of iodine or other semi-volatile materials and radicactive aerosols are treated by one or more of the processes such as scrubbing, sorption and filtration in order to capture almost all the radioactive material. In present and past reprocessing facilities, excess process water, containing a low concentration of radioactivity, has been discharged into local rivers and streams. In the staff's model facility, the excess water will be vaporized into the atmosphere and the vaporizer concentrate will be recycled to the plant waste system. Whether the excess water is discharged into streams or into the atmosphere is immaterial to this proceeding. The vaporization process will not reduce the amount of tritium that is released. That extra step can, however, be expected to reduce the amount of strontium and cesium and other less volatile radionuclides which would otherwise be released in the aqueous effluent from the plant.

d. Releases of Tritium, Krypton-85 and Carbon-14

For purposes of Table S-3, the staff has assumed that all the tritium, krypton-85 and carbon-14 in the spent

fuel is discharged to the environment. No party in this proceeding contends that the staff has underestimated the releases of these three nuclides. We find that the 18,000 ci release of tritium from reprocessing is an over-estimate by a factor of 1.2 to 1.6 because of the factors discussed *supra*. The overestimate is likely to be greater because a substantial amount of tritium may be found in the fuel cladding. The krypton release of 400,000 ci is also an overestimate by a factor of 1.2 to 1.7 because of the factors discussed *supra*, and the staff may also have used a high value for the yield of krypton-85. Whether the carbon-14 release is an overestimate is uncertain because the amount of nitrogen in the reactor fuel is variable.[12] The value of 24 ci/RRY in Table S-3 is what one might realistically expect to be released from fuel that contains nitrogen impurity well into the medium to high range of values. We find that the use of the 24 ci emission value is reasonable.

e. Releases of other Radionuclides

The releases of other radionuclides depend on the effectiveness of the systems designed to contain them. The effluent control measures proposed for the staff's model facility have not been operated in the combinations proposed and some have been tested only in the laboratory. The staff has examined each control system in detail and has calculated the releases on the basis of what it concludes is the lower range of performance of each of the systems. The designers of Barnwell and the NFRRC expect the systems to be one to two orders of magnitude more effective than has been assumed by the staff. However, the Sierra Club, among others, contends that the control measures have not been developed and demonstrated sufficiently to support the use of decontamination factors for the model facility that greatly exceed those demonstrated in the NFS facility.

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[12] The carbon-14 in the fuel is produced by neutron reaction with nitrogen-14 impurity in the fuel.

The staff has used a decontamination[13] factor of 40 for iodine in the reprocessing facility. This results in a release of 0.03 ci/RRY of iodine-129 and 0.83 ci/RRY of iodine-131. This decontamination factor was arrived at on the basis that 90 percent of the iodine would be released into the off-gas from the dissolver and 10 percent would remain in solution with the fuel and other fission products. The off-gas stream would be scrubbed with a mercuric nitrate-nitric acid solution and passed through silver zeolite sorbers with an overall decontamination factor of 10^3 or more. The iodine in the solution would eventually enter the vaporizer where mercuric nitrate would be added to obtain a decontamination factor of 4 and an overall iodine decontamination factor of 40.

We find that the staff has considerably overestimated the likely release of iodine from the reprocessing facility. Laboratory studies have shown that 99 percent or more of the iodine can be volatilized into the dissolver off-gas stream. Methods are also available for substantially reducing the release of iodine from the liquid waste stream.

Iodine-131 has an 8-day half life, and based on a realistic appraisal of reprocessing prospects, will have decayed away before reprocessing is likely to begin. The iodine-129 removed in reprocessing would be packaged and shipped to a disposal facility. For the purposes of Table S-3, whether the iodine-129 is released in reprocessing is of no consequence. The staff has assumed that all the iodine-129, 1.3 ci/RRY, would be released from spent fuel and escape to the environment if spent fuel were disposed of as waste in a repository. The value for total release has been included in Table S-3.

The staff has used a decontamination factor of 1×10^8 for ruthenium-106, 5×10^8 for non-volatile fission prod-

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[13] Decontamination factor as used here is the ratio of the number of curies of a radionuclide entering the plant in the fuel to the number of curies released in the effluents.

ucts such as strontium-90 and cesium-137, 2 x 10^3 for plutonium and 5 x 10^8 for other TRU nuclides in estimating the release from the reprocessing facility. The lower decontamination factors for ruthenium and plutonium reflect the greater volatility of ruthenium under some conditions and the greater amount of processing of the plutonium. These decontamination factors compare with a decontamination factor of about 10^5 measured for ruthenium, strontium and cesium at NFS.

On the basis of the record before us we are persuaded that faulty design and possibly faulty operation of the acid concentrators and waste evaporators at NFS were largely responsible for the low decontamination factors experienced there. We find the evidence convincing that the decontamination factors assumed by the staff for its model can be achieved and probably surpassed by use of well engineered evaporator systems and the air filtration systems that are now in use.[14] The Sierra Club expressed concern that ruthenium and technetium would be volatilized and released in the process of solidifying the high level wastes. We believe that the results of the Waste Solidification Engineering Program (WSEP) provide sufficient evidence that the waste solidification process will not cause the ruthenium-106 releases to exceed those estimated by the staff.[15] Although no measurements of decontamination factors for technetium were made during the tests, chemical considerations support a conclusion that technetium would be contained at least equally well. We find that the staff has overestimated the amounts of ruthenium, non-volatile fission products and TRU nuclides that are likely to be released during normal operation of a model reprocessing facility.

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[14] This evidence while not found in the conclusional statements in NUREG-0116 and the GESMO report, NUREG-0002, is obtained from technical reports referenced in these documents.

[15] See our Summary Report, p. 58.

A substantial fraction of the technetium will accompany the uranium through the Purex process. Some of the participants in this proceeding questioned whether the technetium could be separated well enough from the uranium, during the fluorination, for the uranium hexafluoride to meet the specifications for feed for the enrichment plant, and whether the technetium would be released to the environment from the fluorination process. We find that this record [16] indicates that the uranium hexafluoride can be decontaminated sufficiently and the technetium can be contained and packaged for disposal as a waste.

Except for the releases discussed above, all the radioactivity that enters the reprocessing facility decays or is packaged as solid waste for shipment to a disposal facility. The magnitude of further releases depends on how well the radioactivity is contained during the subsequent interim storage, shipment and handling, and how well it is confined by the media in which it is finally buried.

f. Occupational Exposure

The staff has estimated that the occupational exposure to workers in the reprocessing facility would be 1250 person-rem per year or 22 person-rem/RRY. This exposure was calculated on the basis of the number of people in various work zones and design values for the radiation levels in those zones. The estimate is for normal operation, including minor incidents, but does not include exposures incurred in recovering from major accidents or unexpected equipment failures.

The Sierra Club contends that the staff's estimate is much too low.[17] This contention is based on comparison

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[16] See Summary Report, pp. 59-60, particularly notes 136, 139, 141, 143 and 144.

[17] See our Summary Report, pp. 64-66.

with occupational exposures experienced at NFS and consideration of the much larger amount of more highly irradiated fuel that would be reprocessed in the model facility. However, the testimony of the Sierra Club indicates that operation of the NFS was mostly abnormal and the need to reduce occupational exposures was one of the reasons for shutting down the plant for modifications. In a similar vein Dr. Walton A. Rodger,[18] a witness for BG&E, in answer to Board questions stated that approximately 40% of the total occupational exposure at NFS came from problems with the cranes, shears, saw and the whole process mechanical end (Tr. 863). He also noted that in 1968 and 1969 when the plant was operating reasonably well and had its largest throughput (150 and 136 tonnes for 1968 and 1969, respectively), total occupational exposure (permanent plus temporary workers) was about 900 man-rem. However, in 1970 and 1971 when major maintenance work was being performed throughput dropped to 37 tonnes (1970) and 69 tonnes (1971), but exposures rose to 1531 and 2366 man-rem respectively (Tr. 867 and 870). Dr. Rodgers expressed confidence that lessons learned from NFS would produce exposures at the Barnwell and NFRRC facilities within the staff's estimate.

Future facilities will be designed and operated to comply with the Commission's ALARA requirements. However, the staff's values are based on calculations, are unsupported by reference to experience in any of the U. S. Government plants and appear to allow no margin for major maintenance. Therefore, we cannot find the exposure values to be conservative for a model facility that reprocesses fuel cooled for only 160 days.[19] But, on the

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[18] Dr. Rodger had several years personal experience with operation of NFS.

[19] Note, however, our recommendation, pp. 65-66, *infra*, concerning the staff model which uses the 160-day decay time before reprocessing.

evidence presented on the designs of Barnwell and the proposed NFRRC as compared with NFS and realistic decay times, there is reasonable assurance that the staff's estimate of occupational exposures is realistic.

B. *Interim Storage*

Present concepts of facilities for disposing of HLW and spent fuel that is treated as waste, are based on the assumption that the radioactivity will have decayed for ten years or more before those wastes are placed in a geologic repository. The decay eases the problems of cooling and handling the waste, and increases the amount that can be stored per unit area of repository. Other TRU wastes, including plutonium, could be disposed of shortly after they are generated. When repositories for permanent disposal will be available is uncertain, so the staff has considered the impacts of longer interim storage in deriving the values for Table S-3.

1. Wastes from Fuel Reprocessing

The canisters of solidified HLW are to be stored in a water basin at the reprocessing facility for five years or more until the radioactivity has decayed for ten years after removal from the reactor. The staff assumed that the waste might then have to be shipped to a Retrievable Surface Storage Facility (RSSF) where it would be stored for up to twenty years until a geologic repository becomes available for permanent disposal. The sealed storage cask concept was specified for storing the canisters of HLW at the RSSF on the recommendation of a committee of the National Academy of Sciences. (NUREG-0116, Section 4.2.5, Refs. 1 and 4).

The packaged TRU wastes were assumed to be stored at the reprocessing facility for 15 to 20 years before being shipped to a geologic repository. The drums of cladding hulls and hardware, which generate appreciable

heat, would be stored in the fuel storage basin. Other packaged, solidified waste would be stored in an earth-covered concrete vault.

The containers of plutonium oxide would be stored at the reprocessing facility for up to five years. Then, if a permanent repository were not available, they would be shipped to a facility with a capacity specified to be sufficient for storage for twenty years. For interim storage, each container of plutonium oxide would be placed in a pressure vessel that would be inserted in a stainless steel lined hole in a thick concrete slab. Air would be circulated through the holes to remove the heat from decay of the radioactivity.

Water basins are used for storing highly radioactive materials throughout the nuclear industry. The other facilities for interim storage of wastes from fuel reprocessing have been studied in conceptual designs. None of the facilities presents problems so difficult or unique as to raise serious questions of practicality. The staff assumed that some radioactivity would be released from containers that were contaminated or were damaged or failed during shipment, handling and storage. The facilities would be equipped with air filtration systems and equipment for processing liquid waste. The staff estimated that the amount of radioactivity released during normal operation of the interim storage facilities would be small in comparison with the amount released during reprocessing.

Although questions were raised, no participant took serious issue with the staff's choice of facilities for interim storage or the assessment of the impacts of normal operation. We find that the staff choice of facilities is reasonable. Because of the uncertainties as to when permanent repositories for waste will be available and when or whether reprocessing facilities will operate, it is necessary to include interim storage, beyond that at the reprocessing facility, in the staff model. The assump-

tion that such storage would be for about twenty years seems to be as reasonable for the purposes of Table S-3 as any other that might be made at the present time. We consider the staff's assessments of the impacts and releases from normal operations to be reasonable. Although the impacts from interim storage of plutonium were not fully analyzed the staff's judgment that they would not significantly increase the values in Table S-3 seems reasonable.

2. Spent Fuel

Although some capacity for storage of spent fuel is provided at the nuclear power plant, additional capacity will be required if spent fuel is disposed of as waste. The staff assumes that the spent fuel will be stored in water basins for ten years and then placed in canisters and shipped to a Federal repository for storage.

Water basins are in use for storing fuel elements at the nuclear power plants and the technology is well established. A small fraction of the spent fuel is expected to leak radioactive materials into the pool water. About one percent of the krypton-85 in the fuel would be released to the atmosphere. The radioactive materials in the pool water would be removed, packaged and shipped to a burial facility. We find that the staff has chosen a reasonable facility for interim storage of spent fuel and has made a reasonable analysis of the environmental impacts. Some participants in this proceeding indicated that the fuel would have to be stored longer before repositories could be brought into operation, and that deterioration of the cladding for longer storage in water could lead to greater releases and impacts. The evidence indicates that deterioration of the cladding is unlikely to be serious during storage times of the order of twenty years. Also, increases in the values for releases of volatile nuclides during interim storage would be compensated by decreases in the values for releases from the

geologic repository.[20] We find that the assumption of longer interim storage of spent fuel would have little or no effect on the values in Table S-3. This Board, however, is greatly concerned that consideration of the environmental impact of temporary storage of spent fuel has not, to this date, resulted in any positive action to build off-site interim storage facilities for the rapidly mounting volume of spent fuel. The record here indicates that within five years the lack of such storage space will have serious environmental and economic impacts on the country.

C. *Disposal of Radioactive Waste in a Geologic Repository*

The staff has assumed that the HLW, TRU waste, and plutonium from reprocessing of the spent fuel will be disposed of by burial in a geologic repository in bedded salt. This mode of disposal has been under study since 1957 when it was recommended as a promising method by a committee of the National Academy of Sciences-National Research Council. Experience was gained in the handling of radioactive waste in a salt mine in Project Salt Vault. A large program has been in progress for several years on design studies for a repository and on the thermal, chemical, mechanical, radiation and safety problems that can be foreseen. Field investigations have been undertaken to determine promising locations for repositories.

We see no reason to doubt that the model repository could be constructed and operated to bury the wastes as proposed. The testimony in the record, including statements by the U.S. Geological Survey, supports the con-

[20] For purposes of its cost analysis, the staff assumed that the spent fuel would be stored in water basins at the reactor facilities for ten years. It would then be packaged and transported to an RSSF where it would be stored for twenty years. Storage in a pool would serve equally well.

clusion that sites can be found which satisfy the criteria being developed by the Department of Energy and the NRC. A substantial number of investigations would have to be made at the site before beginning construction, as the mine was being opened, and, possibly, during the first years of operation in order firmly to establish site suitability.

1. Releases of Radioactive Material before the Mine is Closed.

In its analysis of the environmental impacts of normal operation, the staff assumed that some radioactive material would be released during the handling and emplacement of the wastes. Radioactive particles would be removed from the ventilating air by HEPA filters and the radioactive gases would be discharged to the atmosphere. The amount of radioactivity released would be very small except in the case of disposal of spent fuel. The staff assumed that all the tritium, krypton-85, carbon-14 and iodine-129 would be released from the spent fuel.[21] This assumption was made on the grounds that the fuel canister and cladding would be corroded by the salt and those nuclides or their volatile compounds would be released by the fuel. The staff assumed that after the repository was backfilled with salt and the shafts were filled and sealed no radioactive materials would be released.

2. Integrity of the Sealed Mine

The major concern with regard to the integrity of the repository is whether water might enter, dissolve the radioactive materials, and transport them to the biosphere. The staff's position is in part based on the fact that the salt in which the waste would be buried would have existed for millions of years free of water except for

[21] In calculating the release the staff assumed that the radioactivity had decayed for only five years after discharge of the fuel from the reactor.

a small amount of entrapped brine, and could be expected to continue to so exist. The location would be one of low seismic and volcanic activity and with few resources important to man, so the probability of intrusion by nature or by humans would be small. Salt is plastic and would tend to heal some types of intrusions. Furthermore, if water were to reach the repository and dissolve the waste, natural barriers provided by media surrounding the salt would slow the rate of transport so that most of the radioactivity would decay before it could reach the biosphere.

a. Effects of Heat

Concern was also expressed on this record that the presence of the repository might create conditions that would give access to water from aquifers in strata above and below the bedded salt. One matter that has been of particular concern is the effect of the temperature rise produced by heat released by decay of the radionuclides. It has been suggested that excessive temperatures in the region surrounding the waste would result in migration of brine to the waste. Furthermore, chemical reactions might occur that would make the waste more easily transportable. In addition, the heating of the earth in the vicinity of the repository would cause some expansion of the salt and rock, and thus uplift the surface. As the radioactivity continued to decay, and the heat dissipated, the surface would subside. These events might produce fractures that would give water access to the salt.

Measures can be taken to reduce the temperature gradients in the vicinity of the waste canisters, so that the maximum temperature and the severity of the effects of heating in a given repository are governed by the specific heat rate in kilowatts per acre. Heat rates of 150 kw/acre and a maximum temperature of 250°C in the salt are among the emplacement criteria that have often been mentioned. For a given repository the maximum tem-

perature and the heat effects would be reduced by reducing the emplacement density and, thereby, the heat rate.

Insofar as the staff's impact analysis and the values in Table S-3 are concerned, reducing the emplacement density and heat rate would increase the land committed, the energy consumed and the heat released by the facility operations. During this proceeding the staff proposed to change Table S-3 on the basis that spent fuel, or HLW, TRU waste and plutonium combined, would be emplaced such that the heat rate would be 24 kw/acre or less for the model situation that was calculated. With these conditions the average temperature rise in the salt at the waste disposal level would be less than 30°C. The surface would be raised less than 0.8 meters in 1000 years and would subside over tens of thousands of years. The calculations were only illustrative of what one might expect in a model situation. Much more elaborate analysis would have to be made for specific repository sites. However, the calculations indicate that measures can be taken to satisfy the concerns about temperature effects.

b. Mine Shaft Sealing

Another major concern is with the mine shafts and bore holes that pass through aquifers and into or near the repository. Unless the holes are sealed when the repository is closed they would provide pathways for water to reach the waste. Development work is in progress that the staff believes will provide reliable seals. It is expected that, over the long term, the salt would flow and maintain the seals in the zone within the salt bed. Whether failure of a seal would lead to release of radioactivity depends on many circumstances. The waste would be buried deep within the salt bed. Information in the record indicates that large flows of water over salt beds dissolve the salt away at rates of the order of five or six feet per 1000 years. Or, if all the water flowing through the aquifers above a potential repository site in New Mexico were

diverted to flow through the salt, it would take 50,000 years to dissolve the salt associated with one year's waste.[22]

We find that the staff has described a reasonable facility for the deep burial of the HLW, TRU waste, plutonium and spent fuel. The values for the environmental impacts, as modified during the proceeding, are based on substantial information, are reasonable for most impacts and highly conservative with regard to releases of radioactivity from spent fuel. We find a high degree of assurance that the radioactivity will be confined to the vicinity of the repository for hundreds of thousands of years after the repository has been closed and sealed. According to the record, geological, hydrological and other studies will be carried out, before the repository is built and during its operation, to provide assurance that the criteria necessary for the long term operation of the repository will be met. The areas will be posted with permanent markers to deter intrusion by man.

c. Catastrophic Events

We find substantial reason to accept the staff's assumption that the waste will remain undisturbed for millions of years, although this cannot be proven. Several studies have been made of the possible consequences of events that might cause radioactivity to be released. If a very large meteor were to strike the earth above the repository it could penetrate to the waste. Some of the radioactivity would be dispersed into the atmosphere. Most of the radioactivity would be deposited over an area within several miles of the repository. The local consequences would be severe but worldwide consequences would not. The probability of such an event occurring would be extremely low and the risk is small. (NUREG-0116, Section 4.4.2, Ref. 1).

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[22] Summary Report, pp. 87, 88.

Earthquakes or other events might open paths for water to reach the waste. Again, depending on the circumstances, local consequences could be severe. But the probability of an event occurring or of the conditions being the most unfavorable are generally judged to be low and the risks small. (*Ibid.*)

After a few hundreds years, the radioactive nuclides in the waste will have decayed sufficiently that the carbon-14, iodine-129, technetium-99, and plutonium and other TRU nuclides in the waste are the principal hazards. For purposes of Table S-3 the staff has assumed that the carbon-14 and iodine-129 are released, but that the other nuclides decay before they can reach the biosphere. The studies on the retention of plutonium by soils (including the experience at the OKLO site) indicate that the staff's assumption of no release to the biosphere is reasonable for the purposes of Table S-3.

We find that the staff has described a reasonable model facility for the geologic disposal of radioactive waste and has made reasonable estimates of the environmental impacts of normal operation of the facility.

D. *Shallow Burial of Low Level Waste*

The staff has assumed that the low level radioactive wastes that contain less than 10 nci/g of TRU nuclides will be disposed of by shallow burial in licensed facilities located on state or federal land. This method has been used for many years. As a result of experience at existing burial facilities, some of which has not been satisfactory, the staff has developed criteria for future burial facilities. Its analysis of environmental impacts is based on a model facility that satisfies those criteria. The present burial facilities at Branwell, South Carolina and Beatty, Nevada satisfy most or all the criteria. It is generally agreed that many locations that satisfy the criteria can be found.

The staff's analysis assumes small releases while the burial facility is operating and no release to the biosphere after the facility has been closed. Monitoring of the environs, maintenance of the cover over the burial area, and restricted usage of the site may be required for several hundred years after the facility has been closed in order to prevent releases.

We find that the siting and operation of future facilities for shallow burial of low level waste can be expected to be improved over those of the past. The information available indicates that the staff may have underestimated the amount of waste that must be disposed of, particularly the amount from decommissioning of facilities by immediate decontamination and dismantlement.[23] However, increasing the permanently committed land to compensate would increase the total permanent commitment in Table S-3 by only a few percent. We find the staff's estimates of the other impacts from normal operation to be reasonable. They are generally so small that they could be in error by factors of 2 or 3 without much effect on the overall values in Table S-3.

The validity of the staff's assumption with regard to the long term release of radionuclides is much less certain. The nuclides of most concern here are nickel-59 and nibium-94 (from reactor components and corrosion products), iodine-129, technetium-99, and the TRU nuclides. Because of the good sorptive properties of many soils, it is reasonable to expect that the TRU nuclides, nickel and nibium, unless complexed by reaction with constitutents of the waste, would remain in the burial area. Over the very long term iodine and technetium could migrate with the ground water.

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[23] According to the Battelle studies (NUREG-0395 or NUREG/CR-130) the burial volume from decommissioning a large PWR would be about 18,000m^3 or 450 to 600m^3/RRY as compared with the staff's value of 360m^3/RRY for the decommissioning of all the fuel cycle facilities.

Likely modes of transfer of the radioactivity into the biosphere are intrusion by man, erosion, and dissolution over very long times. These are being considered in developing the limits on amounts and concentrations of the various radionuclides that will be permitted in waste disposed of by shallow burial in the future. The objective is to set limits such that individuals making unrestricted use of the disposal area and subjected to exposure by the other processes at times after the strontium-90 and cesium-137 have decayed would not receive excessive doses of radiation.

We find that the staff assumption of no release underestimates the amount of radioactivity that is likely to be released to the biosphere from shallow burial facilities over the long term. We consider the matter further in our recommendations.

E. *Accidents and Sabotage*

In arriving at values for impacts of fuel reprocessing and waste disposal, the staff considered the impacts that might result from accidents in each of the model facilities and processes. The accidents are described briefly in NUREG-0116 and the GESMO report NUREG-0002 and in more detail in the safety analysis reports for the Barnwell and NFRRC facilities and in other principal references. They include minor accidents that would release no radioactivity, but emphasize events that have the potential for releasing large amounts. These include explosions and fires in process equipment and cells, rupture of waste canisters during handling, and events as locally catastrophic as the impact of a large meteor on a waste repository. For the purposes of the accident analyses, the HLW was assumed to be packaged as the calcined material and the plutonium as a fine powder, both readily dispersible forms, so that the calculated releases would tend to be conservative.

As a result of its analyses, the staff concluded that the impacts from accidents would be only a few percent of the impacts from normal operation and did not include them in the values in Table S-3. Although the amount of radioactivity released in a major accident could be greater than that released during a considerable period of normal operation, the frequency of such accidents and the net impact were judged to be relatively small. During the licensing process, each facility for reprocessing and waste disposal is subjected to an extensive safety analysis. A wide range of potential accidents is analyzed. Measures are taken in the design and operating procedures to reduce the probability of any accidents and to provide assurance that the probability of having an accident involving a large release of radioactivity is very low. We find that the staff's conclusion is reasonable.

After considering the impacts of sabotage, the staff concluded that, overall, those impacts would be small in comparison with the impacts of normal operation and need not be explicitly included in Table S-3. This conclusion was based on the fact that acts of sabotage tend to resemble accidents. Measures provided to mitigate the effects of accidents should also mitigate the effects of sabotage. Moreover, the Commission now requires that substantial measures be taken to protect nuclear facilities from sabotage including measures to protect against groups of highly motivated, well trained saboteurs. We find the staff's conclusion reasonable.

F. *Socioeconomic Effects*

The staff considers the socioeconomic effects associated with the construction and operation of a reprocessing plant or a waste disposal facility to be essentially the same as those from the construction and operation of a reactor. These effects include the noise and dust of construction activities; disruptions or dislocations of residences and businesses; impacts on public services such as

education, utilities, road systems, recreation and public health and safety; increased local expenditures for services and materials; social stresses; and such items as increased revenues and business in jurisdictions where such facilities are located.

Witnesses for the States of Ohio and Wisconsin asserted that the staff's consideration of socioeconomic effects of the fuel cycle was cursory. This claim was made on the basis of their theory that the psychological stress and economic benefits from fuel cycle facilities would be different than those from a reactor because

(1) The security at the fuel cycle plants would be greater and more obvious than at reactors, and

(2) The benefits of the reactor would be more obvious as a source of electricity to the local residents than would the remote benefits from the fuel cycle facilities

The witnesses also stated that, because public perception of the risks and benefits of reprocessing and waste management, including its international implications, may decide where and under what constraints fuel cycle facilities can be sited, it must be assessed in evaluating socioeconomic impacts.

NRDC witness, Dr. Todd R. LaPorte considered the staff's analysis to be inadequate because it was not supported by a thorough systems analysis of the nuclear fuel cycle industry as it is projected to expand to the year 2000 and beyond. Such an analysis would have to address local, national and international aspects of technical, political and social problems.

Drs. LaPorte and Deese[24] were concerned that the staff's methodology of relating the socioeconomic impacts to one reactor year did not give a true picture of the scale of operations and the impact on local residents (par-

[24] Dr. LaPorte was a witness for NRDC and Dr. Deese for the States of Wisconsin and Ohio.

ticularly with regard to transportation to and from the plant) at any particular fuel cycle facility. This lack of information, according to these witnesses, leaves the public uncertain as to the true socioeconomic impacts of any given facility.

Baltimore Gas and Electric, *et al.* and TVA strongly supported the staff. BG&E pointed out that under the new regulations security is essentially the same at the reactor as it will be at the fuel cycle plants. TVA gave examples of the efforts it, as a federal resource agency, has made to ameliorate adverse socioeconomic impacts by grants and assistance to local communities.

The Board finds that the staff's appraisal of socioeconomic effects was adequate with the possible exception of the local effects of transportation. The local impacts depend on the site and size of plant and are difficult to generalize. These will, however, be examined in detail in the studies made for licensing each actual reprocessing or waste disposal facility.

We concur in the staff's conclusion that the magnitude of the socioeconomic impacts will be similar to those associated with a nuclear power plant, which is a project of similar magnitude. Since each reprocessing and waste disposal facility would serve many power plants, the fraction that appears in the value in Table S-3 for a single plant is small and is not intended to reflect the total industry impact. Although a thorough systems analysis of an expanding nuclear power industry could provide a somewhat better understanding of the potential socioeconomic impacts and of ways to reduce adverse impacts, we do not believe that the lack of such a detailed analysis invalidates the staff's conclusions.

G. *Decommissioning*

In its initial testimony (NUREG-0116) the staff discussed the environmental impacts of decommissioning of

fuel cycle facilities. It was noted that several options were available (*e.g.*, mothballing (or lawaway), protective storage, entombment or decontamination). The staff chose to consider decontamination shortly after decommissioning because this option would have the greatest environmental and economic impact due to handling and disposing of large amounts of radioactive material and would provide the most conservative values of impacts for use in Table S-3.

While the parties were in disagreement on whether the staff assumption of immediate decontamination is reasonable, the principal issue that developed was the economic cost of decommissioning the nuclear power plant.

The Board finds the staff's evaluation of the impacts of decommissioning the nuclear facilities to be reasonable in most respects. As noted in section D, *supra*, more recent studies have indicated that the volume of radioactive waste generated in decommissioning a nuclear power plant is likely to be larger than the amount used by the staff. Also, no studies have been made of the decommissioning of enrichment plants so wastes from that operation are not included. On the other hand, the Board considers the assumption of immediate decontamination to be unrealistic and to result in an overestimate of the likely impacts. The Board's findings with regard to the costs of decommissioning a nuclear power plant are discussed in section H, *infra*.

H. *Economic Feasibility*

The subject was included in this proceeding by our order of December 23, 1977, following requests made by the states of New York, Ohio and Wisconsin. The capital and operating costs of the reprocessing and waste disposal facilities are in part determined by the measures taken to confine the radioactivity. Statements in the decision of the Court of Appeals led us to decide that testimony should be received on whether building and operat-

ing the model facilities chosen by the staff, to limit the impacts to the values in Table S-3, would be prohibitively expensive.

As a result of our order the staff submitted supplemental testimony [25] on the costs of fuel reprocessing and waste management. This testimony relied heavily on the estimates of such costs prepared for the GESMO proceeding.[26] Supplemental information was used to update the GESMO estimates and to provide estimates of costs of facilities that had not been included in GESMO. The data included estimates of facility costs for reprocessing, low and high level waste disposal, spent fuel disposal and transportation. The accuracies of the components of the capital cost were estimated to be in the range of ± 20 to ± 50 percent.

During the hearings, we made a special effort to assure that the costs of all facilities had been included and properly distributed to individual reactors.[27] At our request, the staff revised and supplemented their testimony to specifically indicate the methods used to distribute the reprocessing and waste management costs.

The staff arrived at an overall capital cost of $71 million per reference reactor for the reprocessing and waste disposal facilities for the uranium-only recycle option and $76 million for the spent fuel disposal option. These costs are less than 10 percent of the capital cost of a reference

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[25] Staff Testimony on Economic Data to Support the Feasibility of the S-3 model (dated February 3, 1978).

[26] Generic Environmental Statement on the use of recycled Plutonium in Mixed Oxide fuels in light water cooled reactors. NUREG-0002, August 1976.

[27] This requires careful consideration since not all components have the same relative capacity or life expectancy. While a reprocessing plant might have a life expectancy of 30 years and serve some 50 reactors, some facilities may have shorter life expectancy or lower capacity and must therefore be duplicated.

reactor.[28] They include a few facilities, such as krypton-85 removal and storage, that were not included in the staff models.

The staff estimated that the discounted cost of managing the waste would be $4.9 million per RRY or 0.6 mills/kW-hr for the uranium recycle option and $3.1 million or 0.4 mills/kW-hr for the spent fuel disposal option. In its cost calculations the staff used a discount rate of 10 percent as recommended by the Office of Management and Budget.

The staff did not include the cost of reprocessing fuel in the model facility in its estimates, but, based on the GESMO analysis the cost would be $260 to $360/kg uranium.[29] This would amount to $9 to $13 million/year or 1.3 to 1.8 mills/kW-hr [30] and would be reduced by the value of the uranium recovered.[31]

The State of New York (New York) provided an analysis of the economics of some phases of waste management and reprocessing and contended that the staff has failed to demonstrate the economic feasibility. As we read the record this contention is based primarily on

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[28] A reference reactor is said to cost about $1 billion but this can vary considerably depending on where it is constructed and what facilities are included in the cost.

[29] Page 35 of Attachment 2 of the staff's supplemental testimony indicates that the cost of reprocessing fuel in a 1500 MT/yr plant that cost $500 million and $100 million per year to operate would range from $145/kg uranium for a 9 percent/year return on investment to $190/kg for a return of 14 percent. The reprocessing cost for the same range of return would be $260 to $360/kg in a 2000 MT/yr model facility costing $1.6 billion and $150 million/yr to operate.

[30] The reprocessing cost to the reactor is independent of whether one assumes a capacity factor of 0.8 and 35 MT/RRY reprocessed or 0.7 and 30 MT/RRY reprocessed.

[31] A value of $120 to $170/lb for the recovered uranium would be required to compensate for the entire reprocessing cost.

disagreement with the staff's discounting of waste management costs, disagreement with the magnitude of the staff's estimate of the cost of decommissioning a nuclear power plant, the belief that the reprocessing cost will be much higher than $350/kg, and the definition of economic feasibility. Except as will be discussed below, we find no differences between the staff's estimates of costs and those put forward by New York that would markedly affect the economic feasibility.

New York contends

> that not only is the 10% discount rate economically unrealistic, but that the use of any discounting mechanism in connection with nuclear waste management is irresponsible as a matter of public policy.[32]

New York considers 0 to 2 percent to be a more realistic return on investment when inflation is taken into account.[33] Based on the staff's cost estimates, the waste management costs for the uranium recycle option would be 1.6 and 2.3 mills/kW-hr for discount rates of 2 and 0 percent, respectively. For the spent fuel discard cycle the corresponding costs would be 1 and 1.4 mills/kW-hr.[34] New York also contends that the staff had used excessively long times for storage of the various wastes in discounting the costs. This is a matter of judgment, but if the times are too long the staff's estimates include more facilities than would be needed for shorter storage periods.

The staff's estimate of the cost of waste management includes $30 million for the decommissioning of the model reactor facility. This estimate was based on a detailed study of the decommissioning of a nuclear power plant

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[32] Final Statement of the State of New York, p. 12.

[33] *Id.*, pp. 14-15.

[34] *Id.*, based on values in Table 1.

that was prepared for the Atomic Industrial Forum. The magnitude of the estimate was corroborated by the results of an even more detailed study by the Battelle Pacific Northwest Laboratories.[35]

New York's witness, Mr. Skinner, estimated that the uninflated decommissioning cost would be about 25 percent of the original facility cost or $300 million for a $1.2 billion nuclear power plant and that this cost would greatly increase the cost of the back end of the fuel cycle.[36] His estimate was not based on a detailed analysis of the decontamination, dismantling and disposal operations but on a study of the percent-of-original facility cost of decommissioning the Elk River Reactor and the Sodium Reactor Experiment. Mr. Skinner made a critical review of the AIF and Battelle studies in which he discussed what he believed to be gross deficiencies in the cost estimates.

Based on the record before us we find that the AIF and Battelle estimates, grounded on detailed studies of plants, more nearly represent the costs of decommissioning than do Mr. Skinner's estimates. We recognize the substantial uncertainties that could exist in the estimates, but are unable to find errors of a factor of 8 to 10 that would be required to raise the AIF and Battelle costs to

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[35] The results of the Battelle study were published as NUREG-CR-0130, Technical Safety and Costs of Decommissioning a Reference Pressurized Water Reactor Power Station. The cost of immediate decontamination and dismantlement was estimated to be $42.1 million.

[36] We note here, as we failed to do in the Summary of the Record in our Report to the Commission, that Dr. Bupp, in supplementary testimony on behalf of the States of Wisconsin and Ohio, stated that "* * * decontamination and decommissioning costs in the range of Skinner's estimates could have a significant and perhaps decisive impact on the economics of nuclear power. * * * For such an addition implies incremental electricity costs in the range of tens of mills per kilowatt-hour; not mills per kilowatt hour." (P. 2). Dr Bupp did not comment on the accuracy of the estimates.

those of Mr. Skinner.[37] Furthermore, we believe that the cost of decommissioning the nuclear power plant is misplaced when it is included in the cost of the back end of the fuel cycle. Decommissioning is considered in the licensing of each nuclear power facility. The cost is specific to each plant and depends on the method chosen. Controversies regarding the decommissioning costs should be resolved in individual reactor licensing proceedings.

New York estimated that the cost of reprocessing would be in the range of $350 to $900/kg of uranium.[38] The $350/kg was obtained for conditions similar to those assumed by the staff. The $900/kg was calculated on the assumption that the facility would operate at only half the design rate (0.4 capacity factor) and on a rate of return well above the range considered reasonable by the staff. We have found (p. 15, *supra*) that a capacity factor of 0.7 is reasonable for the model facility. We also find that the rates of return used by the staff are reasonable and that a reprocessing cost at the lower end of New York's range is a reasonable assumption for the purpose of assessing the economic feasibility.

From the discussion above we have capital costs for reprocessing and waste management of 10 percent or less of the cost of a nuclear power plant. We also have a cost for waste management of 0.4 to 1.4 mills/kW-hr for the spent fuel discard option and a combined cost for reprocessing and waste management of 1.9 to 3.9[39] mills/kW-hr minus the value of the uranium recovered

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[37] Although Mr. Skinner was critical of cost estimates, Attachment 3 to his Responses to Hearing Board Oral Questions showed that the estimated cost of decommissioning the Elk River Reactor was $5.1 million as compared with an actual cost of $5.7 million.

[38] New York's costs were based on analyses made by Dr. Barry J. Smernoff.

[39] The number is not the sum of 1.8 and 2.3 mills/kW-hr because about 10 percent of the undiscounted waste management cost was also included in the reprocessing cost.

for the uranium recycle option. These ranges of values depend entirely on the discount rate and rate of return on investment used in the calculations.

New York's position, as we understand it, is that the staff has not considered all the financial factors and their uncertainties and has not proved that the facilities can be financed or that the costs will not be much greater than presented here. Moreover, New York claims, the economic feasibility of building new nuclear power plants is so marginal that:

> * * * a purportedly small increment of 3% to 10% tends to push weak nuclear economics into "unambiguous non-feasibility." [40]

Whether costs of this magnitude are sufficient to make nuclear power economically unfeasible in some or all locations will depend on the cost of power from other sources and will be determined in the marketplace. Our requirements for a showing of economic feasibility are less than those of New York. We do not consider costs of the order of 10 percent of the total power cost to be prohibitive.[41] More importantly, the costs are not so large as to provide a major incentive for reducing them at the expense of increasing the radioactive effluents above the values included by the staff in Table S-3. The staff's estimates indicate that the undiscounted cost of disposal of spent

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[40] Final Statement of the State of New York, p. 39.

[41] In his supplementary testimony Dr. Bupp stated, "The economics of nuclear power has become a swamp in which it is possible to 'prove' anything one wishes by judicious choice of assumptions. * * * His (Mr. Skinner's) estimates of fuel transportation and storage costs (not including decommissioning costs) are higher than many earlier estimates. But, even if Skinner is correct, these costs do not in my opinion decisively alter the economics of nuclear power relative to realistic near-term alternatives. The prospect of additional potential costs on the order of several mills per kilowatt-hour which Skinner's estimates imply has limited practical meaning in the present circumstances." (P.).

fuel as a waste would add less than 5 percent to a 30 mill/kW-hr cost of power. Presumably, the value of the materials recovered or other incentives would have to reduce the costs to this level or below in order for the uranium recycle option to be chosen. Accordingly, we find the model facilities described by the staff to be economically feasible.

I. *Transportation*

No serious issue was raised in the proceeding concerning transportation. The Board finds the staff's analysis of the environmental impacts of transportation to be reasonable. However, this assumes that the indicated shortage of shipping casks will be overcome in timely fashion.

III. *Board Recommendations*

As is evident in the findings we have made in section II, we believe that this proceeding has provided the additional record required by United States Court of Appeals for the District of Columbia. However, as the result of this supplemental record we believe that changes should be made in Table S-3 beyond those proposed by the staff in its concluding statement for this proceeding.[42]

In making our recommendations we have taken into consideration the recent Commission announcement of its intent to update the supporting documents for the S-3 rule.[43] As a result we are recommending certain modifications in the presently published S-3 Table before adoption as a final rule, while suggesting further changes be made during the updating action.

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[42] Staff Concluding Statement, May 18, 1978. Revised Table S-3 is included as Appendix A of the staff document and is included with this report as Attachment 1.

[43] NRC action—advance notice of intent to update WASH-1248 (supporting document for Table S-3), 10 CFR 51, 20. 43 Fed. Reg. 39801.

A. *Summary of Recommendations*

1. Table S-3 as modified and recommended by the staff should be adopted as the final rule in this proceeding.

2. Table S-3 should be accompanied by a brief explanatory narrative.

3. For updating the rule:

a. The staff should base its analysis on models that are consistent and realistic in terms of the conditions of today and the foreseeable future.

b. The staff's estimates of environmental impacts should be conservative but not so conservative that the values produced are impossible for a realistic model.

c. Technetium releases and their impact should be considered by the staff.

d. The environmental dose commitments should be determined for 100 years.

e. Socioeconomic impacts should be included in the rule but economics need not be included.

f. Information should be included in the narrative so that the impacts of one year's operation can be converted to approximate cumulative impacts.

B. *Adoption of Final Rule in this Proceeding*

We believe that Table S-3 as modified and recommended by the staff in Appendix A of the Staff Concluding Statement (Attachment A to this report) satisfies the requirements of the Court and should be adopted as the final rule in this proceeding. Overall, the values for resources used and effluents released in fuel reprocessing and waste disposal that were incorporated in the Table are conservative. The major controversy in this proceeding was concerned with the amounts of radioactive materials released and the magnitudes of the environmental dose commitments and health effects resulting from those

releases. The record would support the adoption of other values for some of the releases. The effect would be to reduce the total number of curies released and some of the calculated impacts. Because of uncertainties in the values for some of the releases and in the calculation of the impacts, we consider it appropriate, at this time, to adopt the values proposed by the staff.

By amendment to the rules on April 14, 1978 (43 F.R. 15613) population doses and health effects were removed from Table S-3 and made subject to litigation in individual reactor licensing proceedings. Although the record in this proceeding contains much testimony on the calculation of dose commitments and health effects, it does not provide a sufficient basis for placing values for those impacts in Table S-3 and removing them from further litigation.

C. *Need for Explanatory Narrative*

In its present format Table S-3 presents a column of numbers that represent such items as land committed, water used, and effluents released. In a second column an idea of the magnitude of the impact of some of these items is given by comparison with power plants. For some effluents only the major source is given, or the concentration of pollutant is said to be insignificant. Titles of the three supporting documents are given in a footnote.

Table S-3 is intended for use in arriving at an overall cost/benefit balance in the licensing of nuclear power plants. If all the impacts of the fuel cycle could be expressed in the Table in terms of familiar impacts of the operation of a power plant or other common facility, other explanation might not be necessary. However, the radiological impacts and some others cannot be described in this manner. We conclude, therefore, that Table S-3 should be supplemented by a brief explanatory narrative.

The staff has taken a first step toward such a narrative in its draft of Appendix A to Section 5.7 of the Environmental Standard Review Plan (Attachment B to this report). We believe the narrative should contain a brief description of the fuel cycle with references to specific sections of reports where more detailed information can be obtained. The numbers in Table S-3 should be related to the major sources in the narrative and the impacts should be explained.

Environmental dose commitments resulting from the radiological releases should be discussed in the narrative. Health effects could be included or dealt with in the discussion of the health effects of reactor operation. Socioeconomic impacts should be discused but economics need not be included.

The bases, including major assumptions, that have been used to evaluate the impacts should be made clear. References to specific sections of supporting documents should be provided. Hopefully, the narrative could be adopted as part of the rule in a future proceeding and remove the fuel cycle impacts from litigation in reactor licensing proceedings.

D. *Recommendations for Updating the Rule*

1. The Models Should be Realistic

For the purpose of evaluating the environmental impacts the staff should describe model fuel cycles and facilities that are realistic and consistent throughout. The performance of the model facilities should be evaluated conservatively, but the model should not be made unrealistic in order to force the analysis to be conservative. Until a firm decision is made with regard to reprocessing, fuel cycles that involve reprocessing and those that involve disposal of spent fuel as waste are realistic options.

The assumption that reprocessing will begin within 160 days after the fuel has been discharged from the

reactor is unrealistic for any model that involves the reprocessing of fuel from LWR's. Even if the Barnwell reprocessing facility were activated immediately and the full requirement of reprocessing plants were built as rapidly as is likely to be possible, it appears that the backlog of spent fuel would not be worked down to a five-year cooling period for at least 20 years. To assume only 160 days cooling for the sole reason of deriving a larger value for the possible amount of radioactivity in the effluents released from the reprocessing plant, only serves to detract from the credibility of the staff's analysis. For similar reasons, the need for realism extends to assumptions regarding the facilities and the time for interim storage of spent fuel.

2. The Analyses Should Be More Realistic

The staff should make conservative estimates of the amounts of radioactivity in the effluents from the model facilities, but the amounts should not exceed what is possible or reasonable for a realistic model. Because of the time factors discussed above, iodine-131 would decay away before reprocessing and the amounts of ruthenium-106, tritium and krypton-85 would be reduced by decay. The records shows that means are available to extract krypton and to reduce the iodine releases well below the values assumed by the staff.

For spent fuel disposal the assumption that all the tritium, krypton-85, iodine-129 and carbon-14 will escape from fuel that has decayed for only a few years needs to be reexamined. The facts presented in this proceeding indicate that such rapid release is unlikely. The EPA has promulgated regulations that require the release of iodine-129, krypton-85 and TRU nuclides from the fuel cycle be kept far below the amounts now in Table S-3.

We recommend that the staff use more realistic appraisals of the information that is available when estimating the amounts of radioactivity likely to be released

in plant effluents. Such appraisals can be expected to result in lower values for some entries in Table S-3. Where major uncertainties exist, they should be noted and their implications should be discussed.

The need for realism also extends to the analysis of releases from waste disposal facilities. There should now be, or soon will be, enough information available on sites which appear to satisfy the criteria for disposal of low level or high level wastes to enable the staff to make realistic estimates of the releases over the short and long term. We do not see that such analyses need prejudge the licensability of a site.

3. Technetium-99

Technetium-99 is considered to be one of the least hazardous of the fission products and has been mostly ignored in the impact analyses. The assumption that all the iodine-129 is released tends to compensate for the neglect of technetium, but an assumption of releases within the EPA limits would not. Based on the record in this proceeding, one would have to assume that technetium in the uranium sent to an enrichment facility will enter the biosphere in effluents from the plant and from waste disposed of by shallow burial. It might enter from other sources, also. Estimates of technetium-99 releases to the environment and the resulting impacts should be included in the staff's analyses.

4. Inclusion of Man-Rem data in S-3 Table.

Whatever values are finally chosen for the radioactive emissions to be used in Table S-3 if they are stated only in curies, they will remain essentially meaningless to all but the experts insofar as a measurement of environmental impact is concerned.

At present the environmental impacts of *reactor* effluents of radioactive nuclides carried through the various pathways to man are expressed first in curies emitted

then in man-rems as a measure of their impact. To make the added impact of radioactive effluents from the fuel-cycle meaningful they too should be expressed in terms of man-rem as part of the S-3 rule.

It is our recommendation that man-rem impacts should be presented in the narrative of the S-3 rule in terms of the 100-year[44] environmental dose commitment and a long term environmental dose commitment. In each case the dose commitments should be compared with the potential doses from natural background radiation. Since such comparative data can be expressed for any arbitrary population, we suggest the use of the presently estimated population of the United States in the year 2000.[45]

If desired, the estimated man-rem dose commitments may be utilized to estimate potential health effects in Table S-3 or dose commitments can be added to those of specific reactors and the total potential health effects calculated. The staff should choose the method most convenient to them for use in their environmental statements.

5. Socioeconomics and Economics

The socioeconomic impacts of construction and operation of the power plant are among the impacts considered in the environmental statement for the licensing of each

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[44] This time period has been suggested by the Environmental Protection Agency (EPA).

[45] As the Court of Appeals for the Ninth Circuit has observed, an environmental impact statement "need not discuss remote and conjectural consequences." *Sierra Club* v. *Hodel*, 544 F.2d 1036, 1039 (see also *Swain* v. *Brinegar*, 542 F.2d 364, 368 (7th Cir. 1976) and *Trout Unlimited* v. *Morton*, 509 F.2d 1276, 1283 (9th Cir. 1974)). The estimates of man-rem dosage from wastes material alone beyond 100 years become increasingly speculative. We feel that choosing an arbitrary population, with the natural background as a basis of comparison, gives some meaning to the significance of long range fuel cycle impacts for any specific time period.

nuclear power plant. The fuel cycle rule should reflect consideration of an equal range of impacts and should, therefore, include socioeconomic effects. On the other hand, the fuel cycle costs are examined as part of the total power costs in the reactor licensing proceeding and need not be included in the fuel cycle rule.

6. Cumulative Impacts

Table S-3 and the narrative would report the environmental impacts normalized to operation of one reactor for one year. The Court, among others, has commented that it is misleading to focus solely on incremental impact.[46] Some of the numerical values can be multiplied by an assumed lifetime for the reactor to obtain an idea of the total impact of the power plant and then by a number of reactors to approximate the impact of an industry. Other impacts cannot be scaled in this way. The narrative should contain information that would enable the reader to convert the normalized numbers into approximate values of cumulative impact.

IV. *Additional Board Comments*

A. The Staff is presently in the process of establishing new criteria for design and suitability of locations for low level waste disposal facilities. These criteria include the technical requirements for design, type of soil, hydrology, etc. The record of the proceeding indicates that the technical requirements and the operational requirements will be thoroughly examined before any new facility is licensed to operate. The same can be said for new reprocessing facilities. They will have to be designed and constructed to high standards and it will have to be concluded that the releases will be as low as reasonably achievable (ALARA) before a facility will be licensed to operate.

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[46] *NRDC* v. *NRC*, *supra*, n. 3, 547 F.2d at 639, fn. 12.

The record indicates that the one commercial reprocessing facility and some of the low level waste disposal facilities were designed and licensed on the basis that the releases would be less (much less in some instances) than were experienced. Although some problems were caused by faulty design and inexperience many of the difficulties were due to poor management and inadequate quality assurance. In some cases the problems were compounded by lack of cooperation or coordination between the NRC, or its predecessor, and the states.

The values in Table S-3 are based on the assumption that the releases of most of the radioactive nuclides and the occupational exposures will be ALARA. We believe that a major responsibility of the staff will be to ensure that the management and quality assurance practices at the facilities are adequate to ensure that the releases do not exceed the design criteria.

B. Because the availability of the facilities assumed in the staff models is an essential ingredient to the realism of the models, we repeat here our statement at pages 31-32, *supra*:

> This Board, however, is greatly concerned that consideration of the environmental impact of temporary storage of spent fuel has not, to this date, resulted in any positive action to build off-site interim storage facilities for the rapidly mounting volume of spent fuel. The record here indicates that within five years a lack of such storage space will have serious environmental and economic impacts on the country.

We stress that the failure of the staff to adequately address the environmental impacts of the lack of temporary storage is not so serious as to warrant invalidation of Table S-3. However, we believe that the Commission should direct the staff to promptly undertake an assessment of these environmental impacts and consider

the results in the process of updating Table S-3. Should the staff's assessment of such impacts reveal them to be greater than presently foreseen, the Commission will then be in position to take appropriate action.

V. *Conclusion*

In view of the foregoing discussion this Hearing Board recommends that the modifications described in section III.B. (pp. 62-63), *supra*, be made in the presently published Table S-3 before the Commission adopts it as a final rule. We further recommend that the Commission supplement the final S-3 rule with an accompanying narrative such as suggested in section III.C. (pp. 63-64), *supra*. Finally, we recommend that the changes in Table S-3 outlined in section III.D. (pp. 65-70), *supra*, be made during the updating process.

FUEL CYCLE RULEMAKING
HEARING BOARD

/s/ Michael L. Glaser
MICHAEL L. GLASER

/s/ John H. Buck
JOHN H. BUCK

/s/ R. Beecher Briggs
R. BEECHER BRIGGS

October 26, 1978

Attachments—2

ATTACHMENT A

TABLE S-3

Summary of environmental considerations for uranium fuel cycle[1] (Normalized to model LWR annual fuel requirement [WASH-1248] or reference reactor year [NUREG-0116])

Environmental considerations	Total	Maximum effect per annual fuel requirement or reference reactor year of model 1,000 MWe LWR
Natural Resource Use		
Land (acres):		
Temporarily committed[2]	[94] 100	
Undisturbed area	[73] 79	
Disturbed area	22	Equivalent to a 110 MWe coal-fired powerplant.
Permanently committed	[7.1] 13	
Overburden moved (millions of MT)	2.8	Equivalent to 95 MWe coal-fired powerplant.
Water (millions of gallons):		
Discharged to air	[159] 160	= 2 percent of model 1,000 MWe LWR with cooling tower.
Discharged to water bodies	11,090	
Discharged to ground	[124] 127	
Total	[11,373] 11,377	< 4 percent of model 1,000 MWe LWR with once-through cooling.
Fossil fuel:		
Electrical energy (thousands of MW-hour)	[321] 323	< 5 percent of model 1,000 MWe LWR output.
Equivalent coal (thousands of MT)	[117] 118	Equivalent to the consumption of a 45 MWe coal-fired powerplant.
Natural gas (millions of scf)	[124] 135	< 0.4 percent of model 1,000 MWe energy output.
EFFLUENTS—CHEMICAL (MT):		
Gases (including entrainment):[3]		
SO_x	4,400	
NO_x[4]	1,190	Equivalent to emissions from 45 MWe coal-fired plant for a year.
Hydrocarbons	14	
CO	29.6	
Particulates	1,154	
Other gases:		
F-	.67	Principally from UF_6 production, enrichment, and reprocessing. Concentration within range of state standards—below level that has effects on human health.

Table S-3—Continued

Environmental considerations	Total	Maximum effect per annual fuel requirement or reference reactor year of model 1,000 MWe LWR
HCl	.014	
Liquids:		
SO^{-}_{4}	9.9	From enrichment, fuel fabrication, and reprocessing steps. Components that constitute a potential for adverse environmental effect are present in dilute concentrations and receive additional dilution by receiving bodies of water to levels below permissible standards. The constituents that require dilution and the flow of dilution water are: NH_3—600 cfs. NO_3—20 cfs. Fluoride—70 cfs.
NO^{-}_{3}	25.8	
Fluoride	12.9	
Ca^{++}	5.4	
Cl^{-}	8.5	
Na^{+}	12.1	
NH_3	10.0	
Fe	.4	
Tailings solutions (thousands of MT)	240	From mills only—no significant effluents to environment.
Solids	91,000	Principally from mills—no significant effluents to environment.
Effluents—Radiological (curies):		
Gases (including entrainment):		
Rn-222		Presently under reconsideration by the Commission.
Ra-226	.02	
Th-230	.02	
Uranium	.034	
Tritium (thousands)	18.1	
C-14	24	
Kr-85 (thousands)	400	
Ru-106	.14	Principally from fuel reprocessing plants.
I-129	1.3	
I-131	.83	
Fission products and transuranics	[0.023] .203	
Liquids:		
Uranium and daughters	2.1	Principally from milling—included in tailings liquor and returned to ground—no effluents, therefore, no effect on environment.
Ra-226	.0034	From UF_6 production.
Th-230	.0015	

Table S-3—Continued

Environmental considerations	Total	Maximum effect per annual fuel requirement or reference reactor year of model 1,000 MWe LWR
Th-234	.01	From fuel fabrication plants—concentration 10 percent of 10 CFR 20 for total processing 26 annual fuel requirement for model LWR.
Fission and activation products	5.9×10^{-6}	
Solids (buried on site):		
Other than high level (shallow)	11,300	9,100 Ci comes from low level reactor wastes and 1,500 Ci comes from reactor decontamination and decommissioning—buried at land burial facilities. 600 Ci comes from mills—included in tailings returned to ground. 60 Ci comes from conversion and spent fuel storage. No significant effluent to the environment.
TRU and HLW (deep)	1.1×10^{7}	Buried at Federal Repository.
Effluents—thermal (billions of British thermal units)	[3,462] 4,063	<5 percent of model 1,000 MWe LWR.
Transportation (person-rem):		
Exposure of workers and general public	2.5	
Occupational exposure (person-rem)	22.6	From reprocessing and waste management.

[1] In some cases where no entry appears it is clear from the background documents that the matter was addressed and that, in effect, the Table should be read as if a specific zero entry had been made. However, there are other areas that are not addressed at all in the Table. Table S-3 does not include health effects from the effluents described in the Table, or estimates of releases of Radon-222 from the uranium fuel cycle. These issues which are not addressed at all by the table may be the subject of litigation in the individual licensing procedures.

Data supporting this table are given in the "Environment Survey of the Uranium Fuel Cycle," WASH-1248, April 1974; the "Environmental Survey of the Reprocessing and Waste Management Portion of the LWR Fuel Cycle," NUREG-0116 (Supp. 1 to WASH-1248); and the "Discussion of Comments Regarding the Environmental Survey of the Reprocessing and Waste Management Portions of the LWR Fuel Cycle," NUREG-0216 (Supp. 2 to WASH-1248). The contributions from reprocessing, waste management and transportation of wastes are maximized for either of the two fuel cycles (uranium only and no recycle). The contribution from transportation ex-

cludes transportation of cold fuel to a reactor and of irradiated fuel and radioactive wastes from a reactor which are considered in Table S-4 of § 51.20(g). The contributions from the other steps of the fuel cycle are given in columns A-E of Table S-3A of WASH-1248.

[2] The contributions to temporarily committed land from reprocessing are not prorated over 30 years, since the complete temporary impact accrues regardless of whether the plant services one reactor for one year or 57 reactors for 30 years.

[3] Estimated effluents based upon combustion of equivalent coal for power generation.

[4] 1.2 percent from natural gas use and process.

ATTACHMENT B

The staff's analysis and conclusions are as follows:

A. *Land Use*

The total annual land requirement for the fuel cycle supporting a model 1000 MWe LWR is about 41 hectares (101 acres). Approximately 3 hectares (7 acres) per year are permanently committed land, and 38 hectares (94 acres) per year are temporarily committed. (A "temporary" land commitment is a commitment for the life of the specific fuel-cycle plant, e.g., mill, enrichment plant, or succeeding plants. On abandonment or decommissioning, such land can be used for any purpose. "Permanent" commitments represent land that may not be released for use after plant shutdown and/or decommissioning.) Of the 38 hectares per year of temporarily committed land, 29 hectares are undisturbed and 9 hectares are disturbed. Considering common classes of land use in the U.S.,* fuel-cycle land-use requirements to support the model 1000 MWe LWR do not represent a significant impact.

B. *Water Use*

The principal water-use requirement for the fuel cycle supporting a model 1000 MWe LWR is that required to remove waste heat from the power stations supplying electrical energy to the enrichment step of this cycle. Of the total annual requirement of 43 x 10^6 m^3 (11,373 x 10^6 gal), about 42 x 10^6 m^3 are required for this purpose, assuming that these plants use once-through cooling. Other water uses involve the discharge to air (e.g., evaporation losses in process cooling) of about 0.6 x 10^6 m^3 per year and water discharged to ground (e.g., mine drainage) of about 0.5 x 10^6 m^3 per year.

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* A coal-fired power plant of 1000 MWe capacity using strip-mined coal requires the disturbance of about 81 hectares (200 acres) per year for fuel alone.

On a thermal effluent basis, annual discharges from the nuclear fuel cycle are about 4% of the model 1000 MWE LWR using once-through cooling. The consumptive water use of 0.6×10^6 m^3 per year is about 2% of the model 1000 MWe LWR using cooling towers. The maximum consumptive water use (assuming that all plants supplying electrical energy to the nuclear fuel cycle used cooling towers) would be about 6% of the model 1000 MWe LWR using cooling towers. Under this condition, thermal effluents would be negligible. The staff finds that these combinations of thermal loadings and water consumption are acceptable relative to the water use and thermal discharges of the proposed project.

C. *Fossil Fuel Consumption*

Electrical energy and process heat are required during various phases of the fuel-cycle process. The electrical energy is usually produced by the combustion of fossil fuel at conventional power plants. Electrical energy associated with the fuel cycle represents about 5% of the annual electrical power production of the model 1000 MWe LWR. Process heat is primarily generated by the combustion of natural gas. This gas consumption, if used to generate electricity, would be less than 0.3% of the electrical output from the model plant. The staff finds that the direct and indirect consumption of electrical energy for fuel-cycle operations are small and acceptable relative to the net power production of the proposed project.

D. *Chemical Effluents*

The quantities of chemical, gaseous, and particulate effluents with fuel-cycle processes are given in Table S-3. The principal species are SO_x, NO_x, and particulates. Based on data in a Council on Environmental Quality report,* the staff finds that these emissions constitute an

* The Seventh Annual Report of the Council on Environmental Quality, September 1976. Figures 11-27 and 11-28, pp. 238-239.

extremely small additional atmospheric loading in comparison with these emissions from the stationary fuel-combustion and transportation sectors in the U.S., i.e., about 0.02% of the annual national releases for each of these species. The staff believes such small increases in releases of these pollutants are acceptable.

Liquid chemical effluents produced in fuel-cycle processes are related to fuel-enrichment, -fabrication, and -reprocessing operations and may be released to receiving waters. These effluents are usually present in dilute concentrations such that only small amounts of dilution water are required to reach levels of concentration that are within established standards. Table S-3 specifies the flow of dilution water required for specific constituents. Additionally, all liquid discharges into the navigable waters of the United States from plants associated with the fuel-cycle operations will be subject to requirements and limitations set forth in an NPDES permit issued by an appropriate state or Federal regulatory agency.

Tailings solutions and solids are generated during the milling process. These solutions and solids are not released in quantities sufficient to have a significant impact on the environment.

E. *Radioactive Effluents*

Radioactive effluents estimated to be released to the environment from reprocessing and waste management activities and certain other phases of the fuel-cycle process are set forth in Table S-3. Using these data, the staff has calculated the 100-year involuntary environmental dose commitment ** to the U.S. population. These cal-

** The environmental dose commitment (EDC) is the integrated population dose for 100 years, i.e., it represents the sum of the annual population doses for a total of 100 years. The population dose varies with time, and it is not practical to calculate this dose for every year.

culations estimate that the overall involuntary total body gaseous dose commitment to the U.S. population from the fuel cycle (excluding reactor releases and the dose commitment due to radon-222) would be approximately 400 man-rem per year of operation of the model 1000 MWe LWR. Based on Table S-3 values, the additional involuntary total body dose commitment to the U.S. population from radioactive liquid effluents due to all fuel-cycle operations other than reactor operation would be approximately 100 man-rem per year of operation. Thus, the estimated involuntary 100-year environmental dose commitment to the U.S. population from radioactive gaseous and liquid releases due to these portions of the fuel cycle is approximately 500 man-rem (whole body) per year of operation of the model 1000 MWe LWR.

At this time Table S-3 does not address the radiological impacts associated with radon-222 releases. Principal radon releases occur during mining and milling operations and as emissions from mill tailings. The staff has determined that releases from these operations for each year of operation of the model 1000 MWe LWR are as follows:

Mining:	4060 Ci	(Ref. 5)
Milling and Tailings: (during active milling)	780 Ci	(Ref. 6)
Inactive Tailings: (prior to stabilization)	350 Ci	(Ref. 6)
Stabilized Tailings: (several hundred years)	1 to 10 Ci/yr	(Ref. 6)
Stabilized Tailings: (after several hundred years)	110 Ci/yr	(Ref. 6)

The staff has calculated population dose commitments for these sources of radon-222 using the RABGAD computer code described in NUREG-0002, Section IV.J of Appendix A (Ref. 4). The results of these calculations for mining and milling activities prior to tailings stabilization are as follows:

Radon 222 Releases		Estimated 100-Year Environmental Dose Commitment (man-rem) per Year of Operation of the Model 1000 MWe LWR		
		Total Body	Bone	Lung (bronchial epithelium)
Mining	4100 Ci	110	2800	2300
Milling and active tailings	1100 Ci	29	750	620
Total		140	3600	2900

When added to the 500 man-rem total body dose commitment for the balance of the fuel cycle, the overall estimated total body involuntary 100-year environmental dose commitment to the U.S. population from the fuel cycle for the model 1000 MWe LWR is approximately 640 man-rem. Over this period of time, this dose is equivalent to 0.00002% of the natural background dose of about 3,000,000,000 man-rem to the U.S. population.*

The staff has also considered health effects associated with the releases of radon-222, considering both the short-term effects of mining, milling and active tailings, and the long-term effects from stabilized tailings. Dose to the bronchial epithelium was used as the standard of comparison. As noted, this dose for mining, milling, and active tailings is approximately 2900 man-rem per year of operation of the model 1000 MWe LWR. For long term radon releases from stabilized tailings, the staff has assumed that these tailings would emit, per year of operation of the model 1000 MWe LWR, 1 Ci/yr for 100 years, 10 Ci/yr for the next 400 years, and 100 Ci/yr for periods beyond 500 years. With these assumptions, the cumulative radon-222 release from stabilized tailings piles per year of operation of the model 1000 MWe LWR will be 100 Ci in 100 years and 53,800 Ci in 1000 years

* Based on an annual average natural background individual dose commitment of 100 mrem and a stabilized U.S. population of 300 million.

(Ref. 7). The bronchial epithelium dose commitments for these two periods are 56 and 30,000 man-rem, respectively.

Using a risk estimator of 22.2 cancer deaths per million man-rem lung exposure, the estimated risk of lung cancer mortality due to mining, milling, and active tailings emissions of radon-222 would be 0.065 cancer fatalities per year of operation of the model 1000 MWe LWR. When the risk due to radon-222 emissions from stabilized tailings over a 100-year release period is added, the estimated risk of lung cancer mortality over a 100-year period is estimated to be 0.066 cancer fatalities per year of operation of the model 1000 MWe LWR and, similarly, a risk of 0.74 cancer fatalities over a 1000-year release period. When all other risks of cancer mortalities (e.g., bone cancer) are considered, the overall risks of cancer fatalities per year of operation of the model 1000 MWe LWR are as follows:

0.11 fatalities for a 100-year period

0.19 fatalities for a 500-year period

1.2 fatalities for a 1000-year period.

To illustrate: A single model 1000 MWe LWR operating at an 80% capacity factor for 30 years would be predicted to induce 3.3 cancer fatalities in 100 years, 5.7 in 500 years, and 36 in 1000 years as a result of releases of radon-222.

These doses and predicted health effects have been compared with those that can be expected from natural-background emissions of radon-222. Using data from the National Council on Radiation Protection (NCRP, Ref. 8), the average radon-222 concentration in air in the contiguous United States is about 150 pCi/m^3, which the NCRP estimates will result in an annual dose to the bronchial epithelium of 450 mrem. For a stabilized U.S. population of 300 million, this represents a total dose commitment of 135 million man-rem per year. Using the

same risk estimator of 22.2 lung cancer fatalities per million man-rem used to predict cancer fatalities for the model 1000 MWe LWR, estimated lung cancer fatalities alone from background radon-222 in the air can be calculated to be 3000 per year. Against this background, the staff concludes that both the dose commitments and health effects of the uranium fuel cycle are insignificant when compared to dose commitments and health effects to the U.S. population resulting from natural background radiation sources.

F. *Radioactive Wastes*

The quantities of buried radioactive waste material (low-level, high-level, and transuranic wastes) are specified in Table S-3. For low-level waste disposal at land burial facilities, the Commission notes in Table S-3 that there will be no significant radioactive releases to the environment. For high-level and transuranic wastes, the Commission notes that these are to be buried at a Federal Repository, and that no release to the environment is associated with such disposal. NUREG-0116 (Ref. 2), which provides background and context for the high-level and transuranic Table S-3 values established by the Commission, indicates that these high-level and transuranic wastes will be buried and will not be released to the biosphere. No radiological environmental impact is anticipated from such disposal.

G. *Occupational Dose*

The annual occupational dose attributable to all phases of the fuel cycle for the model 1000 MWe LWR is about 200 man-rem. The staff concludes that this occupational dose will not have a significant environmental impact.

H. *Transportation*

The transportation dose to workers and the public is specified in Table S-3. This dose is small and is not con-

sidered significant in comparison to the natural background dose.

I. *Fuel Cycle*

The staff's analysis of the uranium fuel cycle did not depend on the selected fuel cycle (no recycle or uranium-only recycle), since the data provided in Table S-3 include maximum recycle option impact for each element of the fuel cycle. Thus, the staff's conclusions as to acceptability of the environmental impacts of the fuel cycle are not affected by the specific fuel cycle selected.

VI. REFERENCES

1. U.S. Atomic Energy Commission, *Environmental Survey of the Uranium Fuel Cycle*, WASH-1248, April 1974.

2. U.S. Nuclear Regulatory Commission, *Environmental Survey of the Reprocessing and Waste Management Portions of the LWR Fuel Cycle*, NUREG-0116 (Supplement 1 to WASH-1248), October 1976.

3. U.S. Nuclear Regulatory Commission, *Public Comments and Task Force Responses Regarding the Environmental Survey of the Reprocessing and Waste Management Portions of the LWR Fuel Cycle*, NUREG-0216 (Supplement 2 to WASH-1248), March 1977.

4. U.S. Nuclear Regulatory Commission, *Final Generic Environmental Statement on the Use of Recycle Plutonium in Mixed Oxide Fuel in Light-Water-Cooled Reactor Cooled Reactors*, NUREG-002, August 1976.

5. U.S. Nuclear Regulatory Commission, In the Matter of Duke Power Company (Perkins Nuclear Station), Docket No. 50-488, Testimony of R. Wilde, filed April 17, 1978.

6. U.S. Nuclear Regulatory Commission, In the Matter of Duke Power Company (Perkins Nuclear Station), Docket No. 50-488, Testimony of P. Magno, filed April 17, 1978.

7. U.S. Nuclear Regulatory Commission, In the Matter of Duke Power Company (Perkins Nuclear Station), Docket No. 50-488, Testimony of R. Gotchy, filed April 17, 1978.

8. National Council of Radiation Protection and Measurements, *Publication 45*, (1975).

10 CFR Part 51

Uranium Fuel Cycle Impacts for Spent Fuel reprocessing and Radioactive Waste Management; Extension of Interim Fuel Cycle Rule

AGENCY: Nuclear Regulatory Commission.

ACTION: Extension of the interim fuel cycle rule.

SUMMARY: The Commission promulgated March 14, 1977 (42 FR 13803) an interim rule identifying the environmental impact values for the uranium fuel cycle which are to be included in environmental reports and environmental impact statements for individual light water nuclear power reactors. The interim rule was made effective for 18 months with the possibility of extension for good cause. The Commission has made five extensions for the period of effectiveness of the interim rule. The most recent extension enlarged this period to July 30, 1979. The Commission now finds good cause to enlarge this period until September 4, 1979, the effective date of the final rule.

DATE: The interim rule published at 42 FR 13803, March 14, 1977 (10 CFR 51.20(e)) is extended until September 4, 1979.

FOR FURTHER INFORMATION CONTACT: Stephen Eilperin, Office of the General Counsel, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555, phone 202-634-3224.

SUPPLEMENTARY INFORMATION: Notice is hereby given that the Nuclear Regulatory Commission has extended through September 4, 1979, the effectiveness of the interim fuel cycle rule 10 CFR 51.20(e) ("table S-3,: as revised). The Commission finds this extension desirable so that there is no gap prior to the effective date of the final rule.

Background

The status of the Commission's interim rule [*sic*] cycle rule and the course of the final rulemaking up to the submission of the Hearing Board's report on the extensive evidentiary record were reviewed in the notice of September 18, 1978 (43 FR 41373), which extended the interim rule through March 14, 1979. Additional extensions have proved necessary, most recently because the Commission needed additional time to consider its course of action in light of the D.C. Circuit's decision in *State of Minnesota* v. *NRC*, No. 78-1269 (May 23, 1979).

The Commission has now completed its consideration of the final fuel cycle rule and that rule is being made effective as of September 4, 1979. In order that there be no gap prior to that effective date the Commission finds good cause to extend the period of effectiveness of the interim rule until September 4, 1979.

It is so ordered.

For the Commission.

Dated at Washington, D.C., this 27th day of July, 1979.

Samuel J. Chilk,

Secretary of the Commission.

[FR Doc. 79-23825 filed 8-1-79; 8:45 am

BILLING CODE 7590-01-M

NUCLEAR REGULATORY COMMISSION

10 CFR Part 51

Licensing and Regulatory Policy and Procedures for Environmental Protection; Uranium Fuel Cycle Impacts From Spent Fuel Reprocessing and Radioactive Waste Management

AGENCY: Nuclear Regulatory Commission.

ACTION: Promulgation of a final fuel cycle rule.

SUMMARY: The Commission promulgated on March 14, 1977 an interim rule identifying the environmental impact values for the uranium fuel cycle which are to be included in environmental reports and environmental impact statements for individual light water nuclear power reactors. After an extensive proceeding focused on the nuclear waste management and fuel reprocessing parts of the fuel cycle, the Commission now promulgates a final rule which sets out revised impact values. The rule also specifies fuel-cycle-related subjects that are to be considered in individual licensing proceedings as part of the environmental cost-benefit analysis for a power reactor. The Commission notes its intention to conduct a further supplementary rulemaking to adopt as part of the rule an explanatory narrative addressing the environmental significance of the impact values tabulated in the final rule. A general update of the rule with respect to all aspects of the uranium fuel cycle is also in progress.

EFFECTIVE DATE: September 4, 1979.

FOR FURTHER INFORMATION CONTACT: E. Leo Slaggie, Office of the General Counsel, U.S. Nuclear Regulatory Commission, Washington, DC, 20555, phone 202-634-3224.

SUPPLEMENTARY INFORMATION: This notice announces the outcome of a final rulemaking by the Nuclear Regulatory Commission regarding the environmental

effects of spent fuel reprocessing and radioactive waste management in the light water power reactor uranium fuel cycle. The rule adopted herein replaces an interim rule which identifies fuel cycle environmental impact values to be included in environmental reports and environmental impact statements for individual light water power reactors. The interim rule, 10 CFR 51.20(e) ("Table S-3", as revised), was published on March 14, 1977 (42 FR 13803) to be effective for 18 months and was extended several times, the final extension being to the effective date of this rule.

This final rulemaking concludes a proceeding which began on May 26, 1977 with a notice that a rulemaking hearing would be held to consider whether the interim rule should be made permanent or, if it should be altered, in what respects. 42 FR 26987. The Hearing Board took extensive written and oral testimony from more than twenty participants. On August 31, 1978 the Board submitted to the Commission a detailed summary of the evidentiary record, followed on October 26, 1978 by its Conclusions and Recommendations.

After studying the Hearing Board's recommendation and receiving written and oral presentations by rulemaking participants, the Commission has adopted as a final rule the modified Table S-3 recommended by the Hearing Board. The impact values in this table differ only slightly from the values in the interim rule. With two exceptions, these values will be taken as the basis for evaluating in individual light water power reactor licensing proceedings, pursuant to requirements of the National Environmental Policy Act (NEPA), the contribution of uranium fuel cycle activities[1] to the environmental costs

[1] The fuel cycle activities addressed by the rule include uranium mining and milling, the production of uranium hexafluoride, isotopic enrichment, fuel fabrication, spent fuel storage and disposal, reprocessing of irradiated fuel, transportation of radioactive materials and management of low-level wastes and high-level wastes. The

of licensing the reactor in question. The exceptions are radon releases, presently omitted from the interim rule (43 FR 15613, April 14, 1978), and technetium-99 releases from reprocessing and waste management activities, as discussed later in this notice. Appropriate values for these releases are open for consideration in individual proceedings.

Promulgation of the revised table is not the sole outcome of this rulemaking. The rulemaking record makes clear that effluent release values, standing alone, do not meaningfully convey the environmental significance of uranium fuel cycle activities. The focus of interest and the ultimate measure of impact for radioactive releases are the resulting radiological dose commitments and associated health effects. To convey in understandable terms the significance of releases in the Table, the Hearing Board recommended that the modified Table be accompanied by an explanatory narrative promulgated as part of the rule. The recommended narrative would also address important fuel cycle impacts now outside the scope of the Table, including socioeconomic and cumulative impacts, where these are appropriate for generic treatment. The Commission has directed the NRC staff to prepare by October 1 such a narrative, as described in more detail later in this notice. The narrative will be submitted for public comment in a further rulemaking.

Pending adoption of an explanatory narrative as part of the fuel cycle rule, the use of Table S-3 in individual proceedings must be accompanied by supplementary presentations. Accordingly, the Commission has directed the NRC staff to continue presenting in individual proceed-

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rulemaking proceeding concluded here dealt only with impacts of reprocessing and waste management and associated transportation, the so-called "back-end" of the fuel cycle. The impacts of transportation of cold fuel to the reactor and irradiated fuel and solid radioactive wastes lie outside the scope of the rule and are treated separately in the Commission's regulations. See 10 CFR 51.20(g).

ings an evaluation of dose commitments and health effects from fuel cycle releases. In addition, the staff will address economic, socioeconomic, and possible cumulative impacts of fuel cycle activities and such other impacts of the fuel cycle as may reasonably appear to have a significance for individual reactor licensing sufficient to warrant attention for NEPA purposes. These matters remain open for litigation in individual proceedings. The present rulemaking settles only the question of fuel cycle release values, with the exceptions noted above, and such other numerical data that appear explicitly in the Table.

In response to a recent decision by the United States Court of Appeals for the District of Columbia Circuit, *State of Minnesota* v. *NRC*, Nos. 78-1269 and 78-2032 (May 23, 1979), the Commission intends to conduct a generic proceeding which will consider the most recent evidence regarding the likelihood that nuclear waste can be safely disposed of and when that, or some other off-site storage solution, can be accomplished. That new generic waste disposal proceeding will be separate and different in scope and purpose from further fuel cycle rulemakings dealing with an S-3 narrative and general update of S-3, but will in part review and update the conclusions regarding waste disposal which have been reached in the present rulemaking. If available, the record compiled in the new generic waste disposal proceeding can be considered in, and made a part of the record in, the general update of S-3.

The background of this proceeding and the reasons underlying the Commission's decision are explained in the material which follows.

I. Need For a Fuel Cycle Rule in Power Reactor Licensing

The National Environmental Policy Act of 1969 (NEPA) requires that the Commission look closely at the environmental impact of a proposed nuclear power

reactor before it may license the construction or operation of the facility. To comply with NEPA the Commission has adopted licensing and regulatory procedures presently set out in 10 CFR Part 51. Under these rules the environmental analysis in a power reactor license proceeding must include a cost-benefit analysis which, among other things, considers and balances the adverse environmental impacts of the nuclear plant against the expected environmental, economic, technical, and other benefits.

The environmental impact of operating a nuclear power reactor is not limited to effects specific to the plant itself, such as site alterations due to plant construction or the release of reactor effluents. The environment will also be affected by the fuel cycle activities necessary to support plant operation. Since operation of a nuclear plant involves a commitment to prepare fuel and dispose of spent fuel and waste, the environmental impacts considered in the NEPA analysis for a power reactor should include contributions from uranium fuel cycle activities.[2]

Evaluating these contributions necessarily involves a wide-ranging inquiry and a certain amount of speculation. Fuel cycle facilities serve many reactors, and there is no way to ascertain with certainty which facility now in existence or to be operated in the future will contribute fuel to a given nuclear power reactor or will receive its irradiated fuel or wastes. Thus the fuel for a particular reactor cannot be identified at the start of the fuel cycle and traced through the various steps to final disposal. Instead, the fuel cycle impacts for a particular reactor must be estimated hypothetically, for example by apportioning the impacts of representative fuel cycle facilities to the number of reactors served. Determining these facility impacts also involves uncertainties, particularly for

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[2] Activities comprising the nuclear fuel cycle are listed in note 1, above.

the back end of the cycle. For example, reprocessing of spent fuel, if it is done, would take place at newly designed facilities, not yet operational. Thus impacts based on previous reprocessing experience using outdated technology are not in the Commission's judgment representative of future impacts. For waste disposal many proposals have been put forth, but the method or methods which will finally be used are as yet unselected. A reasonable approach for determining waste disposal impacts is to focus on a system which seems likely to be deployed and to estimate its impacts conservatively, based on the best available information and analysis.

A study of fuel cycle impact thus involves difficult generic analysis and prediction well outside the normal scope of facility-specific subjects dealt with by a reactor licensing board. This does not mean that the subject can be ignored or deferred until the fuel cycle facilities themselves come up for licensing.[3] It does mean that in reactor licensing fuel cycle impacts should be treated where possible by generic rulemaking rather than case-by-case adjudication.

The Commission's interim fuel cycle rule, 10 CFR 51.20(e), requires that the environmental costs to be considered in a power reactor licensing proceeding shall include contributions from uranium fuel cycle activities as set forth in a table ("Table S-3, Summary of environmental considerations for uranium fuel cycle"). The adequacy of this interim rule, insofar as waste management and reprocessing impacts are concerned, was the original focus of the present rulemaking, as the background discussion in the section to follow indicates. As

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[3] The court of appeals for the D.C. Circuit has specifically rejected such an approach and held that "absent effective generic proceedings to consider these issues, they must be dealt with in individual licensing proceedings." *NRDC* v. *NRC*, 547 F.2d 663, 641 (1976), *rev'd on other grounds sub nom. Vermont Yankee Nuclear Power Corp.* v. *NRDC*, 435 U.S. 519 (1978).

the rulemaking progressed, however, participants submitted a substantial amount of public comment and testimony addressing matters not dealt with by the interim rule, including economic and socioeconomic impacts, numerical uncertainties in the estimates, and long-term dose commitments and health effects. This implicit broadening of the rulemaking's scope called attention to problems which must be addressed in a further rulemaking, but also indicated there may be confusion regarding the proper objective of a fuel cycle rule.

The rule aimed at this proceeding has a limited purpose. It applies only to environmental cost-benefit balances for power reactors and is in no way intended to be a tool for choosing among alternative uranium fuel cycle technologies. Although the rule should reflect as accurate an assessment as reasonably possible of uranium fuel cycle impacts, the rule clearly does not need the detail or the precision of an environmental analysis for licensing fuel cycle facilities themselves. A reasonable degree of uncertainty is unavoidable and is acceptable, given that basic decisions have not yet been made regarding reprocessing and the technology of waste disposal.

The rule need not be comprehensive in scope to be a useful and valid exercise of rulemaking authority. A record is not yet availabe to support a comprehensive rule dealing with all generic aspects of fuel cycle impacts relevant to reactor licensing, but the Commission is free to adopt a narrower rule that for the present leaves some of these matters for consideration in individual proceedings. The table of impacts adopted as a final rule in this proceeding serves as an important first step in this consideration, relieving adjudicatory boards from the need to determine those numerical impacts of the uranium fuel cycle which have been extensively considered in generic rulemaking. Ultimately, however, the impacts of the releases and not the releases themselves dictate the standards the Commission must set. Therefore, use of the table in individual licensing will not

foreclose discussion of the significance of those impacts or other important aspects of the fuel cycle not addressed by the table. This point needs emphasis in view of the background of the Commission's original S-3 rule, which at least initially was apparently interpreted as cutting off further discussion of fuel cycle impacts.

II. Background of the Fuel Cycle Rulemaking

1. *Promulgation and Application of the Original Fuel Cycle Rule, "Table S-3"*

In a Notice of Proposed Rulemaking published November 15, 1972 (37 FR 24191) the Atomic Energy Commission (AEC) announced a proceeding "that would specifically deal with the question of consideration of environmental effects associated with the uranium fuel cycle in the individual cost-benefit analysis for light water cooled nuclear power reactors." As a basis for this consideration the Commission's staff had published a report entitled "Environmental Survey of the Nuclear Fuel Cycle," dated November 6, 1972.[4] Citing the Environmental Survey, the Notice set out two proposed alternatives for public comment and consideration at an informal hearing. Under one alternative, no consideration of fuel cycle impacts (apart from facility-specific effects of transporting cold fuel to the reactor and spent fuel and radioactive wastes from the reactor) would be required in individual proceedings, on the grounds that these impacts as analyzed in the Environmental Survey were sufficiently small not to affect significantly the cost-benefit balance for an individual reactor. Under the second alternative, impact values for fuel cycle costs of licensing a power reactor would be taken in individual licensing proceedings as set forth in Table S-3 of the Environmental Survey.[5]

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[4] A revised version of this Environmental Survey was published in April 1974 as WASH-1248.

[5] The tabulated impacts in Table S-3 included acres of land committed to fuel cycle activities, amount of water discharged by such

Written comments were submitted by more than forty individuals and organizations. The hearing took place February 1 and 2, 1973 before the three-person hearing board, following legislative-type procedures announced by the Commission in a supplemental notice (38 FR 49).

Following the hearing and supplementary written submissions by participants, the board on July 6, 1973 presented to the Commission a 24-page report which identified the major issues at the proceeding but, in accordance with the Commission's direction, made no recommendation.

After consideration of the comments and the hearing record, the AEC on April 22, 1974 (39 FR 14188), adopted the second alternative, under which "the environmental effect associated with the uranium fuel cycle, albeit small, would be factored into individual cost-benefit analyses in the form of numerical values," as set out in Table S-3, with minor revisions to reflect corrections or changes suggested by the hearing record. The Commission noted its view that the values in the table reflected "substantial conservatism" and found it to be a "fact that the environmental effects of the uranium fuel cycle have been shown to be relatively insignificant." The Commission concluded accordingly that there was no need to apply the rule retrospectively.

The Commission stated that it preferred to adopt Table S-3, rather than the alternative of declaring by rule that fuel cycle impacts are not significant for reactor licensing, because in conformance with other regulations the table "quantifies, to the fullest extent practicable, the environmental effects of the uranium fuel cycle

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activities, fossil fuel consumption, and chemical and radiological effluents, the latter in curies, all normalized to the annual fuel requirement for a model 1000 MWe light-water reactor. Notations accompanying the tabulated values included a few radiological doses in man-rem, but no estimates are given of human health effects caused by fuel cycle radiological effluents. The Environmental Survey did not give quantitative estimates of health effects.

in individual cost-benefit analyses." *Cf.* 10 CFR 51.20(b), 51.23(c). Consistent with the Commission's view at that time that Table S-3 represented a full quantitative account of fuel cycle contributions, the text of the rule stated that in applicants' environmental reports and Commission impact statements in individual licensing proceedings this contribution "shall be as set forth in . . . Table S-3 . . . No further discussion of such environmental effects shall be required."

The Commission notice promulgating the rule did not specifically mention health effects, socioeconomic impacts, or cumulative impacts, either to require or preclude their discussions, although it might fairly be concluded that the notice's repeated observation that fuel cycle effects were "insignificant" amounted to a Commission judgment implicit in the rule that no discussion of these effects was formally required. The Commission's regulatory staff applied the rule in practice as allowing fuel cycle impacts to be addressed in reactor licensing proceedings solely by the formal act of displaying Table S-3 in impact statements, with no further discussion. In particular, impact statements prepared by the staff did not analyze fuel cycle impacts in terms of health effects which might be caused by the radioactive releases tabulated in the rule and did not discuss socioeconomic or cumulative impacts.

Almost three years after the rule became effective, the Commission's Atomic Safety and Licensing Appeal Board issued a decision implying that discussion of fuel cycle health effects was desirable when the comparison between the proposed nuclear plant and an alternative coal plant was an issue in the licensing proceeding. *In the Matter of Tennessee Valley Authority* (Hartsville Nuclear Units), 5 NRC 92, 103 (1977). As part of its response to the Hartsville decision, the regulatory staff sought and received permission from reactor licensing boards to introduce evidence of the public health consequences of the nuclear fuel cycle compared with the coal fuel cycle. Cf.

In the Matter of Public Service Company of Indiana, Inc. (Marble Hill Nuclear Generating Station), 7 NRC 179, 187 (1978). As the rule required, health effects in the staff's submissions were based on the tabulated radioactive release values in 10 CFR 51.20(e).[6] By this time, however, the original Table S-3 had been replaced by the amended table in the interim rule as a result of legal developments discussed next.

2. *The Vermont Yankee Decision*

On a petition to review the adequacy of the fuel cycle rulemaking proceedings, the United States Court of Appeals for the District of Columbia Circuit on July 21, 1976 set aside those portions of the rule pertaining to waste management and spent fuel reprocessing. *Natural Resources Defense Council* v. *NRC*, 547 F.2d 633, rev'd *sub nom. Vermont Yankee Nuclear Power Corp.* v. *NRDC*, 435 U.S. 519 (1978). After first holding that fuel cycle impacts must be addressed in reactor licensing,[7] either by an effective rule or in the adjudicatory

[6] The Commission announced on April 14, 1978 an amendment to the fuel cycle rule which removed the release value for radon from the table and left radon impacts open for litigation in individual proceedings. 43 *Fed. Reg.* 15613. Subsequent to this amendment, the staff has been free to introduce evidence of radon-related health effects not based on Table S-3 release values. This notice also confirmed that the rule does not address health effects and does not preclude discussion of health effects in individual proceedings. The notice amended the second sentence of the rule to read: "No further discussion of the environmental effects addressed by the Table shall be required."

Mr. Marvin Lewis, one of the participants in this rulemaking, petitioned the Commission to "vacate" Table S-3 in its entirety, citing as grounds asserted severe health effects from radon releases. The Commission has denied this petition, noting that radon releases are no longer addressed by the table.

[7] The court of appeals consolidated the petition to review the fuel cycle rule with a petition to review an Appeal Board holding in the Vermont Yankee Nuclear Power Station licensing proceeding that

proceeding, the court found the rulemaking record insufficient to support the waste management and reprocessing parts of the rule because the procedures afforded during the hearing were inadequate, at least as applied by the hearing board.[8] The court saw the significance of Table S-3 as an expression "in numerical terms [of] the conclusion that the environmental effects of the fuel cycle, including waste disposal, are insubstantial." *Id.* at 646. With regard to reprocessing and waste disposal, "the focal points for this appeal," the court found that the Environmental Survey failed to provide "detailed explanation and support" for this conclusion and that testimony presented at the hearing did not fill the gap. The court noted that "[t]he only discussion of high level waste disposal techniques was supplied by a 20-page statement by [AEC witness] Dr. Frank K. Pittman,"

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environmental impacts of reprocessing or waste disposal need not be considered in individual reactor licensing proceedings. *In the Matter of Vermont Yankee Nuclear Power Corp.*, 4 AEC 930 (June 6, 1972). The court of appeals rejected the Appeal Board's decision and held that reprocessing and waste disposal issues must be dealt with either by an effective rule or in individual licensing proceedings. The Supreme Court did not disturb this holding when it later reversed the court of appeals. The Supreme Court noted that the Commission "acted well within its statutory authority" in requiring that fuel cycle impacts be considered in reactor licensing proceedings. *Vermont Yankee, Nuclear Power Corp.* v. *NRDC*, 435 U.S. 519, 539 (1978). The Commission in promulgating the fuel cycle rule had stated that the Appeal Board's Vermont Yankee decisions had no further precedential significance insofar as they differed from the rule. 39 *Fed. Reg.* 14188.

[8] Interpreters of the opinion have differed over the relative weight which the court of appeals in reaching its decision attached to procedural inadequacies and to insufficiency of the record. The Supreme Court was persuaded that the "ineluctable mandate of the court's decision is that the procedures afforded during the hearings were inadequate." 435 U.S. 519, 542. The Supreme Court reversed the court of appeals on this procedural question and remanded for consideration whether the evidentiary record supported the rule. The court of appeals has held in abeyance its decision on the remand, pending completion of the Commission's final rulemaking.

which the court criticized for its "conclusory quality." *Id.* at 645, 651. The court found that the procedures employed at the hearing failed to expose this statement to any "probing of its underlying analysis," *id.*, and concluded that the Commission had been arbitrary and capricious to adopt a rule "cutting off consideration of waste disposal issues and reprocessing issues in licensing proceedings based on the cursory development of the facts . . . in this [rulemaking] proceeding." The court vacated those portions of the rule and remanded to the Commission.

In important respects, however, the court of appeals approved the Commission's overall approach to the fuel cycle rulemaking. The court rejected the argument that a fuel cycle rule is itself a major Federal action requiring an impact statement. The court found it sufficient that a NEPA impact statement is prepared when Table S-3 is incorporated into a proposal to license an individual reactor. The court also saw no necessity for a "plenary consideration of alternatives" in evaluating waste disposal impacts for the purposes of the rule, "provided a sufficiently conservative and credible assessment of a particular waste disposal method is used." *Id.* at 653, note 57.

3. *Promulgation of the Interim Rule*

In response to the *NRDC* v. *NRC* decision and a related decision, *Aeschliman* v. *NRC*, 547 F.2d 622 (D.C. Cir. 1976), the Commission on August 16, 1976 issued a General Statement of Policy (GSP) (41 FR 34707) announcing an intention to reopen the fuel cycle rulemaking proceeding to supplement the existing record on waste management and reprocessing impacts and to determine whether or not the rule should be amended. The Commission directed the NRC staff to prepare on an expedited basis a revised and well-documented environmental survey as the basis for an interim rule on waste management and reprocessing impacts. The General Statement of Policy also directed that no new full-power operating licenses,

construction permits, or limited work authorizations should issue, pending the conclusion of a notice-and-comment interim rulemaking. With regard to licenses already issued, the Commission indicated that, if requests for a show cause order based on fuel cycle grounds were received, licensing boards would be assigned to determine whether the licenses in question should be continued, modified, or suspended pending adoption of an interim rule.

The revised environmental survey, NUREG-0116—Supplement 1 to WASH-1248, was completed in early October, 1976, and on October 18 the Commission published a notice soliciting public comment on the survey and a proposed interim rule. (41 FR 45849). Comments received in response to that notice and the Commission's responses to those comemnts were later published in March 1977 as NUREG-0216, Supplement 2 to WASH-1248.

On November 11, 1976 the Commission announced that licensing could resume on a conditional basis (41 FR 49898). As factors in this decision the Commission noted that (1) the court of appeals had stayed its mandate, leaving the S-3 rule formally in effect but conditioning new licenses on the outcome of petitions by licenses for Supreme Court review of the court's decision,[9] and (2) NUREG-0116 provided significant support for the conclusion that waste management and reprocessing impacts are slight, so that the interim rule, when promulgated, would not be likely to produce results in reactor licensing different from the original rule. The Commission also suspended show cause proceedings on fuel cycle grounds against light water reactor licensees. The Commission directed that new licenses could be issued only if a sepa-

[9] The Supreme Court's subsequent grant of certiorari automatically continued the stay of mandate pending completion of Supreme Court Action. The Supreme Court's remand and subsequent action by the court of appeals have left unresolved for the present the question whether the waste management and reprocessing portions of the original S-3 rule were legally sufficient. See note 8.

rate analysis determined that use of the impacts in the proposed interim rule would not tilt the cost-benefit balance against the reactor.

On March 19, 1977 the Commission promulgated the interim rule (42 FR 13803) to be effective for eighteen months, subject to extension for good cause. 10 CFR 51.20(e). In support of the interim rule the Commission noted that the two environmental supplements, NUREG-0116 and NUREG-0216, provided a "sufficient informational basis for the interim rule . . ." The Commission acknowledged that "there are gaps in the information needed for a detailed assessment of waste management and disposal technology" but found that "the costs of not proceeding outweigh the risks of proceeding by interim rule," given that within a relatively short period the issues would be more thoroughly discussed in the final rulemaking proceeding. The Commission terminated show cause proceedings initiated pursuant to the General Statement of Policy, noting that "the values in the interim rule are not sufficiently different from the values in the original Table S-3 to warrant revocation or suspension on cost-benefit grounds [of previously issued licenses]." [10] 43 FR 43806.

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[10] Subsequently the Commission directed the Appeal Board to consider for the ten facilities affected by the terminated show cause proceedings "the particularized factual data essential to making a determination of the incremental effect, if any, that the use of the values in the interim rule would have on the NEPA cost-benefit balances for the particular facilities involved." 5 NRC 717, 7173 (1977). The Appeal Board found that fuel cycle impacts did not tilt the cost-benefit balance against any of the facilities in question, 6 NRC 25, 28-30, 6 NRC, 33, 102-104, 6 NRC 206, 209 (1977), and concluded: "The effects assigned by the interim rule to the uranium fuel cycle are . . . extremely small (as the Commission itself has suggested). This being so, they could not possibly serve to call for the abandonment of any particular nuclear facility unless the cost-benefit balance for that facility was otherwise in virtual equipoise." 6 NRC at 104.

4. *Initiation of the Present Rulemaking*

Following promulgation of the interim rule, the Commission published a notice of hearing which initiated a final rulemaking. 42 FR 26987 (May 26, 1977). The procedures anounced in the notice were the same as those applied in the original hearing, except that specific provision was made for the Hearing Board to entertain suggestions from participants regarding questions which the Board should direct to witnesses or other participants.[11] The subject of the hearing was "confined to the environmental effects of spent fuel reprocessing and radioactive waste management in the light water power reactor uranium fuel cycle, and to the question whether the outcome of the interim rulemaking should be made permanent for future use, or if it should be altered, in what respects."[12] Both NUREG-0116 and NUREG-0216 were specified for inclusion in the hearing record. The fuel cycle was to be taken to include alternatively (1) no reprocessing of spent fuel, or (2) reprocessing of spent fuel for purposes other than recycle of plutonium, with follow-on interim and/or long-term storage or disposal of plutonium and wastes from reprocessing, with plutonium either separated from or included with the wastes.[13]

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[11] On January 26, 1978 the Commission modified the procedures to allow participants to cross-examine witnesses on specific factual issues at the close of the legislative-type hearings, where it could be demonstrated with particularity that the procedure was necessary to prepare a record adequate for a sound decision. No cross-examination in fact occurred. After a special hearing to consider requests, the Board found that the requisite demonstrations had not been made.

[12] With regard to fuel cycle impacts not within the scope of the hearing, the notice observed that the staff had begun a general update which was expected to lead to a separate rulemaking proceeding. A proposed outline for this "update of WASH-1248" was announced by the staff on September 7, 1978. 43 Fed. Reg. 39801.

[13] The impacts from reprocessing, waste management and transportation of wastes given in the interim rule are maximized for

The following parties participated in this reopened proceeding: the staff of NRC; the Environmental Protection Agency; the Department of Interior; the U.S. Geological Survey; the States of California (California Energy Resources Conservation and Development Commission), Delaware, Maryland, Ohio, Wisconsin and New York; Baltimore Gas and Electric Co., et al. (a group of 16 utilities); Commonwealth Edison Co., *et al.* (a group of 8 utilities); the Tennessee Valley Authority; the Allied-General Nuclear Services Co.; Exxon Nuclear Company; Westinghouse Electric Corporation; the Atomic Industrial Forum; the Natural Resources Defense Council; the Pacific Legal Foundation; Environmentalists, Inc.; the Sierra Club; the Union of Concerned Scientists; Mr. Marvin Lewis; and Dr. Chauncey Kepford.

At a prehearing conference held on July 28, 1977 the Hearing Board provided for the submission of written direct testimony by the participants, written questions and answers based on that testimony and follow-up questions, all prior to the start of the oral hearings. These hearings began on January 16, 1978 and concluded in March 1978 after ten days of testimony. During the hearings, in response to a petition by the State of New York, the Board expanded the scope of the proceeding to consider the economic feasibility of the model facilities on which the proposed Table S-3 values were based. The Board conducted all of the questioning during the oral hearings.

The Board compiled an extensive evidentiary record, including the staff's NUREG-0116 and NUREG-0216, the staff's testimony on the economic feasibility of its model facilities, the direct testimony of participants exceeding 1,100 pages, two rounds of written questions pro-

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either of the two fuel cycles considered (no reprocessing and reprocessing only to recover uranium). See note 1 to Table S-3, 10 CFR 51.20 (1978).

pounded by participants and several hundred pages of responses, more than 1,200 pages of transcript of oral hearings, written rebuttal testimony of the parties, and final concluding statements of the parties, filed June 26, 1978.

On August 31, 1978 the Hearing Board submitted a 137-page report to the Commission which summarized this record and outlined the significant issues raised by the participants. Also, responding to the Commission's request for the Board's views, the Board submitted on October 26, 1978 its Conclusions and Recommendations. The Board recommended that the Commission adopt as a final rule a modified Table S-3 proposed by the NRC staff, in which the majority of entries were unchanged from those in the interim rule. The Board also recommended that a "brief explanatory narrative" be adopted as part of the rule, which among other things would interpret the significance of the tabulated impacts in terms of environmental dose commitments. The Board's recommendations identified several aspects of the rule which in the Board's view should be improved upon during the general update of the fuel cycle rule.[14]

Shortly before the Board's recommendations were issued, the Commission announced that it would receive participants' written statements commenting on the rulemaking record and the Hearing Board's recommendations. Nine participants submitted comments, including the NRC staff.[15] Several participants argued that the record did not support adoption of the modified Table S-3. New York State asserted that the record showed the model facilities on which the table was based were not

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[14] See note 12 above.

[15] The nine commenters were Mr. Marvin Lewis, the Natural Resources Defense Council, the Sierra Club, the State of New York, the States of Ohio and Wisconsin, Baltimore Gas and Electric, *et al.*, Commonwealth Edison, *et al.*, the Tennessee Valley Authority, and the NRC staff.

economically feasible. Other opponents of the table argued that the tabulated impact values did not adequately reflect underlying uncertainties revealed by the record. In particular, they questioned basing reprocessing impacts on model facilities rather than past operating experience. The omission of technetium-99 releases from the table was also criticized. Several parties who opposed adopting the table stressed that dose commitments and health effects, economic and socioeconomic impacts, and cumulative impacts were not addressed by the table and were required for an adequate description of fuel cycle environmental impacts. These participants generally supported preparation of an explanatory narrative but urged a broader scope than the one proposed by the Board.

Other participants supported the Board's recommendation for adoption of the modified Table S-3 but questioned the need for an explanatory narrative. They pointed to procedural problems of providing adequate notice before a narrative could be incorporated as part of the rule. Some parties concluded, on the grounds that the D.C. Circuit had not criticized the portions of the original S-3 rule dealing with the front-end of the fuel cycle, that there was no legal requirement for a narrative or for consideration of fuel cycle environmental questions outside the scope of the original Table S-3.

The NRC staff favored adoption of the modified Table S-3 as a final rule but preferred that an explanatory narrative be deferred for preparation as part of the general update. The staff noted that explanatory material subject to litigation in individual licensing proceedings is presently introduced to accompany the use of Table S-3 in such proceedings and recommended that this practice continue.

On January 19, 1979 the Commission heard oral presentations from the commenters. These presentations provided a valuable elaboration of the parties' views but did not change the basic positions stated in the written

comments. The Commission accepted brief supplemental written submissions following the oral presentations and then closed the record of this proceeding as of January 23, 1979.

III. Final Rulemaking

1. *Adoption of the modified Table S-3*

The Commission has found that except for technetium-99 releases the record supports adoption of the modified Table S-3 as a final rule, as recommended by the Hearing Board. The participants' comments and the Board's recommendations have made clear that the Table is not free of flaws, but for the reasons discussed below the Commission believes that these will not significantly impair the Table's usefulness as the starting point for considering fuel cycle impacts in individual reactor licensing proceedings.

To begin with, there can be little doubt that this rulemaking has been adequate from a procedural standpoint. The Supreme Court's *Vermont Yankee* decision confirmed that informal agency rulemaking is procedurally sufficient when the notice-and-comment requirements of the Administrative Procedure Act, 5 U.S.C. 553, are met. 435 U.S. 419 (1978). The fuel cycle rulemaking not only afforded these basic notice-and-comment procedures but also provided extensive additional written and oral procedures, including several not offered by the hearing board in the original S-3 rulemaking. A few participants expressed the view that the record might have been improved, had the Board exercised its discretion to permit cross-examination, but no one has argued that the record is legally deficient from a procedural standpoint.

As noted earlier, however, several comments to the Commission questioned whether the record provides sufficient evidence to support the numbers in the modified Table. The general thrust of these comments was that

the model facilities analyzed by the staff were for one reason or another unacceptable as a basis for determining fuel cycle impacts. The Commission believes that the substance of these comments has been adequately addressed by the Hearing Board in the discussion supporting its recommendations. Conclusions and Recommendations of the Hearing Board, Docket RM-50-3. The issues of greatest importance or special concern to commenters are reviewed in the following subsections.

a. Economic Feasibility. The proposed rule clearly would be open to serious question if the model facilities on which the values in Table S-3 are based would be prohibitively expensive to build and operate. In response to the Board's request for evidence on economic feasibility, viewed in this narrow sense, the staff submitted cost estimates based on material from the GESMO proceeding.[16] From these estimates the Hearing Board found per-reactor costs of reprocessing and waste management to be on the order of ten percent of the total costs for building and operating an individual reactor. The Board concluded that such costs were not prohibitive. Recommendations, page 58.

Comments by the State of New York challenged the Board's conclusion that establishing fuel cycle costs at a few percent of total generating costs sufficed to demonstrate economic feasibility.[17] New York cited testimony

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[16] Generic Environmental Statement on the Use of Recycle Plutonium in Mixed Oxide Fuels in Light Water Cooled Reactors, NUREG-0002, August 1976.

[17] Also, during the hearing and in a separate motion filed before the Commission on December 18, 1978, New York, together with Wisconsin and Ohio, urged that dollar value impacts should be brought within the scope of the S-3 proceeding. The matter of dollar value economic impacts is separate from the issue of economic feasibility. The Commission made clear earlier in an order issued February 9, 1978, Docket RM-50-3, that this rulemaking "was not intended to encompass a full economic analysis leading to inclusion

by its own witnesses asserting that the economics of nuclear power are precarious and that back-end fuel cycle costs will tip this doubtful balance against the nuclear option. This evidence, New York concluded, "mandates a finding of economic infeasibility of the back end of the uranium fuel cycle."

The Commission believes New York missed the distinction between the broad issue of nuclear power economics and the much narrower question of economic feasibility of specific models for waste management and reprocessing. Whether nuclear power is good business is not an issue in this rulemaking. The fuel cycle rule will be used only when someone has decided, rightly, or wrongly, that nuclear power is sufficiently viable economically to warrant applying for a reactor license. Once the reactor has operated, back-end fuel cycle activities must be carried out, whatever the cost. This rulemaking addressed the environmental impact of those activities based on methods and facilities which could on technological grounds reasonably be employed. The economic feasibility question, correctly identified by the Hearing Board, is simply whether these methods might be so outlandishly expensive that there will be a "major incentive for reducing [costs] at the expense of increasing the radioactive effluents above the values * * * in Table S-3." Recommendations, page 58. The Commission believes that the fuel cycle cost estimates arrived at by the Hearing Board took adequate account of matters in controversy and provided a reasonable basis for the

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of economic costs in the uranium fuel cycle rule." The Order left open the possibility that the detailed economic costs of the fuel cycle might be dealt with in a later generic rulemaking. The Commission will refer the States' motion to the staff for treatment as a petition for rulemaking pursuant to 10 CFR 2.802. To the extent that fuel cycle dollar value impacts are relevant to the cost-benefit balance for a reactor they may at present be considered in individual licensing proceedings.

Board's conclusion that the staff's models are economically feasible in the sense described above.[18]

b. Waste Management and Disposal. In determining the impacts associated with waste management and disposal the staff assumed that high-level waste (or reactor spent fuel treated as waste) would be stored in interim facilities (water basins and retrievable surface storage facilities) for about twenty years and then disposed of by burial in a bedded salt geologic repository.[19] The

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[18] The Board's cost estimates took into account New York's vigorous objection to the staff's use of a 10 percent discount rate. The Board computed a range of estimated fuel cycle costs based on return on investment of 2 and 0 percent, suggested by New York as more realistic, and based its judgment on an overall cost estimate large enough to include the upper limit of the range. The Board also noted its view that costs of decommissioning a power reactor, a matter of controversy at the hearing, are facility-specific and should be considered in individual reactor proceedings rather than included among the costs of the fuel cycle activities which are the subject of the generic rule. The Commission finds the Board's reasoning correct on this point and confirms that reactor decommissioning costs are not relevant to this rulemaking.

[19] The program of interim storage followed by geologic disposal is in broad outline the same waste management model considered in the original fuel cycle rulemaking, but the record developed in the present proceeding is far more extensive, particularly with respect to disposal. Dr. Pittman's testimony at the original rulemaking in 1973 consisted largely of a description of a proposed retrievable surface storage facility for continuously monitored interim storage. Concerning ultimate disposal without further surveillance, Dr. Pittman noted that a major effort was underway to determine whether disposal in bedded salt was acceptable, but he did not describe the concept in any detail. In contrast, NUREG-0116. Section 4.4, provides a 30-page quantitative discussion of disposal of long-lived wastes in a bedded salt repository, with citations to many relevant technical documents prepared since 1973. The bedded salt concept was discussed extensively in written and oral testimony at the hearing. For example, the Board's oral examination of witnesses from the United States Geological Survey regarding the characteristics of salt beds as a repository medium occupies 37 pages of the hearing transcript. Tr. 699 ff. Docket RM-50-3. In addition, the present state of knowledge regarding nuclear waste disposal and its im-

staff's interim storage model was not seriously questioned at the hearing. The technology for storing spent fuel elements under water in pools is well established; radioactive releases to the environment have in practice been extremely small and may be expected to remain small, even if pool storage is protracted by delays in establishing disposal facilities. The Commission concludes that the staff analysis of interim storage impacts was reasonable. In any case, the values in Table S-3 would not be significantly affected by any reasonably foreseeable variations from the time periods and models for interim storage assumed by the staff.

Analysis of waste disposal necessarily involves greater uncertainty than interim storage because disposal technology has not yet been selected. Consistent with the court of appeals' ruling that it suffices to assess one credible waste disposal method, rather than the full spectrum of alternatives, NUREG-0116 chose to analyze "deep emplacement in a stable geologic medium (bedded salt) under the continental U.S." The staff concluded that this technology "has the greatest amount of substantive information available from which to summarize environmental impacts" and would be "reasonably representative of impacts that would result from any appropriately designed geological emplacement." NUREG-0116, page 2-9.

The waste repository impacts of greatest concern are radioactive effluents which might escape to the biosphere during the thousands of years which must elapse before radioactivity in the waste has dropped to an insignificant level. For spent fuel disposal the staff made the conservative assumption that fission-product gases in the spent fuel, including all tritium, krypton-85, carbon-

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pacts has been extensively detailed in the Report to the President by the Interagency Review Group on Nuclear Waste Management ("IRG Report"), TID-29442 (March 1979) and the draft Subgroup Report on Alternative Strategies for the Isolation of Nuclear Waste, TID-28818 (Draft), October 1978.

14, and iodine-129, would be released during handling and emplacement of the waste prior to sealing of the repository.[20] This assumption reflects the possibility that the spent fuel storage canisters and the fuel rod cladding will be corroded by the salt during the period the repository is open (roughly 6 to 20 years), and volatile materials in the fuel will escape to the environment. The staff assumed, however, that after the repository is sealed there would be no further release of radioactive materials to the environment.[21]

With regard to this assumption of complete repository integrity, the Hearing Board identified as the major concern the question "whether water might enter, dissolve the radioactive materials, and transport them to the biosphere." The staff assumed such transport would not occur, for reasons summarized by the Board as "in part based on the fact that the salt in which the waste would be buried would have existed for millions of years free of water except for a small amount of entrapped brine, and could be expected to continue to so exist. The location would be one of low seismic and volcanic activity and with few resources important to man, so the prob-

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[20] The numbers in Table S-3 reflect this assumed complete release. In the alternative that spent fuel is reprocessed rather than disposed of directly, the staff's reprocessing model assumed complete release of tritium, krypton-85, and carbon-14 but provided for capture of most of the iodine-129. The value for iodine-129 that appears in Table S-3 is for total release.

[21] NUREG-0116 states (pages 2-10, 2-11): "Long term impacts will be nonexistent if the repository performs as expected and maintains the wastes in isolation. The rationale . . . follows a simple line: since the [bedded salt] formation has been demonstrably undisturbed for many millions of years, there is reason to believe that it will remain undisturbed into the future, even though mildly modified by placing the wastes into it." Supplementing this basic rationale, Section 4.4 of NUREG-0116 provides a detailed review of reasons for believing that a bedded salt disposal system, suitably selected, will prevent significant releases for the full period needed for waste detoxification.

ability of intrusion by nature or by humans would be small. Salt is plastic and would tend to heal some types of intrusions. Furthermore, if water were to reach the repository and dissolve the waste, natural barriers provided by media surrounding the salt would slow the rate of transport so that most of the radioactivity would decay before it would reach the biosphere." Conclusions and Recommendations of the Hearing Board, Docket RM-50-3, page 34.

The Commission finds that these characteristics of a bedded-salt repository afford a reasonable basis for the staff's conclusion that the repository can maintain its integrity, provided that sites meeting the selection criteria can in fact be found and developed. On this key issue the evidence in the record is tentative but favorable. At the hearing a witness for the U.S. Geological Survey testified that he believed it possible to find sites for repositories that would give the low release rates estimated by the staff. Transcript at 729. Although no specific location has yet been identified as meeting the criteria, the widespread distribution of salt deposits favors the view that suitable sites can be found.[22] Such general evidence, coupled with the absence of any strong argument that a site cannot be found, probably affords as strong a record as can be made on the issue until a specific site has been thoroughly investigated and found to be suitable.[23]

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[22] NUREG-0116 notes that salt deposits have been found in 24 of the 50 States. Sec. 4.4.1.2.

[23] In view of the often-cited experience at Lyons, Kansas, it is worth mentioning that the failure of a particular site to meet selection criteria, though discouraging, cannot of itself disprove the feasibility of the bedded-salt repository concept. At Lyons, Kansas, an initially promising site later proved unsuitable because of previously undiscovered bore holes and adjacent mining operations that compromised the integrity of the site. These problems were specific to the site rather than inherent in the concept.

For these reasons and based on this record it is the Commission's judgment that a suitable bedded-salt repository site or its equivalent will be found, but the Commission notes and agrees with the Interagency Review Group on Waste Management that areas of uncertainty remain regarding both the likelihood of finding a site and the probability that it will perform as expected.[24] The Commission's judgment in this regard is limited to the purposes for which this proceeding was brought—namely to specify for NEPA purposes the environmental impacts to be considered in individual licensing proceedings as part of the environmental cost-benefit analysis for a power reactor. It is in no way intended to be a judgment for choosing among alternative technologies for waste disposal. That kind of judgment is in the first instance to be made by the Department of Energy and will be subject to further review in a Commission licens-

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[24] These residual uncertainties were noted in the Report to the President by the Interagency Review Group on Waste Management, TID-29442, March 1979, which was discussed in draft form at the January 19, 1979 oral presentation. Responding to comments on the feasibility of waste disposal in mined repositories, the IRG report states on page 42: "No scientific or technical reason is known that would prevent identifying a site that is suitable for a repository provided that the systems view is utilized vigorously to evaluate the suitability of sites and designs, and in minimizing the influence of future human activities. A suitable site is one at which a repository would meet predetermined criteria and would provide a high degree of assurance that radioactive waste can be successfully isolated from the biosphere for periods of thousands of years. For periods beyond a few thousand years, our capability to assess the performance of the repository diminishes and the degree of assurance is therefore reduced. The feasibility of safely disposing of high level waste in mined repositories can only be assessed on the basis of specific investigations at and determinations of suitability at particular sites. * * * [E]ven at the time of decommissioning some uncertainty about repository performance will still exist." The Commission believes the IRG Report's view that suitable sites can be identified but that uncertainty about repository performance cannot be entirely eliminated is consistent with the record compiled in the fuel cycle rulemaking.

ing proceeding when a particular proposal comes before us. Nor is the Commission making judgments in this proceeding as to the likelihood of waste disposal being accomplished safely. That issue has been addressed separately by the Commission.[25]

Furthermore, the Commission intends in the near future to conduct a generic proceeding to reassess the outlook for the availability of safe waste disposal methods in light of new data and recent developments in the Federal waste management program.[26]

In view of the uncertainties noted regarding waste disposal, the question then arises whether these uncertainties can or should be reflected explicitly in the fuel cycle rule. The Commission has concluded that the rule should not be so modified. On the individual reactor licensing level, where the proceedings deal with fuel cycle issues only peripherally, the Commission sees no advantage in having licensing boards repeatedly weigh for themselves the effect of uncertainties on the selection of fuel cycle impacts for use in cost-benefit balancing. This is a generic question properly dealt with in this rulemaking as

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[25] 42 *Fed. Reg.* 34391, July 5, 1977. See also *Natural Resources Defense Council* v. *NRC*, 582 F.2d 166 (2d Cir. 1978).

[26] The immediate occasion for this proceeding is the D.C. Circuit's remand to the Commission of *State of Minnesota* v. *NRC*, Nos. 78-1269 and 78-2032 (May 23, 1979) to consider whether there is reasonable assurance that an off-site storage solution for nuclear wastes will be available by the years 2007-09, the expiration dates for licenses of certain nuclear plants where the Commission has granted permits to expand on-site spent fuel capacities and if not, whether there is reasonable assurance that the fuel can be stored safely at the site beyond those dates. A continuing reassessment of the Commission's views on waste disposal is part of the commitment which the Commission has made to Congress. The final IRG report, which was available to the fuel cycle rulemaking participants only at the close of the rulemaking and only in draft form, will be part of the new information which the Commission will consider in its reassessment. The Commission will announce at a later date the specific procedures to be adopted for this proceeding and its precise scope.

part of choosing what impact values should go into the fuel cycle rule. The Commission concludes, having noted that uncertainties exist, that for the limited purpose of the fuel cycle rule it is reasonable to base impacts on the assumption which the Commission believes the probabilities favor, *i.e.*, that bedded-salt repository sites can be found which will provide effective isolation of radioactive waste from the biosphere.[27]

Assuming an initially suitable site is found, the Board noted that particular concern had been expressed regarding the possibility that heat released by radioactive decays in the waste might alter conditions in the salt so as to give access to water and promote migration of the waste. As the Board points out in its recommendations, however, the average temperature rises in the salt will depend on the density of waste emplacement. Increasing the amount of land committed to the repository reduces this density and may be expected to be an effective measure for meeting concerns about temperature effects. During the proceeding the staff proposed a modification to Table S-3 raising the acreage committed to waste disposal. This modification is included in the table adopted as the final rule.

Even allowing for some eventual leakage of water into the repository, information in the record indicates that transport of materials out of the repository area would take tens of thousands of years. The only apparent

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[27] Even if, contrary to the evidence in the record and the Commission's expectation, bedded-salt repositories should ultimately be found not adequate, the strong incentive to develop sound waste disposal methods and the major effort now directed to this goal make it likely that a means of effective isolation will be found among the many geologic disposal techniques being considered. The IRG Report (see note 24 above) notes on page 3 that "increased levels of support . . . and broader range of disciplines involved have led to a greatly increased accumulation of knowledge within the [waste management] program. The current rate of growth of knowledge is very large."

natural mechanisms cited which might reasonably cause major releases involved very low probability catastrophic events such as a large meteor strike on the repository or formation of new geologic faulting intersecting the area. Releases through accidental intrusion by man remain possible but in the Commission's view unlikely since casual intrusions should be virtually impossible and sites should be selected in areas offering little incentive for deliberate intrusion in search of natural resources. Given the staff's assumption that volatile fission products are totally released before the repository is sealed, the Commission finds that taking post-sealing releases as zero does not significantly reduce the overall conservatism of the table.

In summary, the Commission concludes, based on the above considerations and the more detailed analysis given in the Board's recommendations, that the staff's model for assessing impacts of waste disposal is reasonable and adequate for the purposes of the fuel cycle rule.

c. Reprocessing. The reprocessing alternative considered in this proceeding involved reprocessing of spent fuel for purposes other than recycle of plutonium.[28] In considering this alternative, the Commission expresses no view on the likelihood that such reprocessing will take place.[29] Under this alternative the staff assumed that

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[28] On December 23, 1977, in response to President Carter's nuclear non-proliferation policy, the Commission terminated proceedings on pending or future plutonium recycle-related license applications and halted proceedings on the Generic Environmental Statement on Mixed Oxide Fuel (GESMO) to determine under what condition uranium and plutonium might be recycled from spent light water reactor fuel and fabricated into fresh mixed oxide fuel on a wide scale. In the Matter of Mixed Oxide Fuel, 6 NRC 861 (1977). See also 7 NRC 711 (1978).

[29] The Commission's instructions to the S-3 Board of January 26, 1978 (Commissioner Gilinsky dissenting) noted that "Although the 'once-through' fuel cycle is currently the reference case for United States policymaking purposes, the possibility of some form of re-

spent fuel after 160 days cooling at the reactor would be shipped to a model reprocessing facility, where the uramium, plutonium, and fission products would be separated by the Purex solvent extraction process into three liquid fractions. The uranium would be converted to uramium hexafluoride for recycling at an enrichment plant. The plutonium, still containing about five percent of the fission products to deter diversion, would be converted to plutonium oxide and packaged for disposal in a Federal waste repository. The high-level liquid waste (HLLW), containing the bulk of the fission products, would be stored up to five years in tanks and then calcined and formed into glass for repository disposal.

No significant question was raised at the hearing regarding the staff's choice of processes, but considerable controversy arose concerning the staff's assumption that the performance of the model facility would show a significant improvement over previous commercial reprocessing experience. The only commercial experience in the United States with reprocessing spent uranium oxide fuel from light water reactors was obtained at the Nuclear Fuel Services plant (NFS) in West Valley, New York. This relatively small plant, which is no longer in operation, had the capacity to process on the order of one metric ton of spent fuel per day but in practice achieved a capacity factor of only 0.33 as compared with an expected 0.8. A high level of radioactive effluent releases was experienced during the NFS operation.

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processing for waste management purposes is not excluded and therefore the Commission decided that this alternative should be included as well. The Commission paid particular attention to the fact that the spent fuel processing surveyed in this proceeding would treat plutonium solely as a waste product and would not make plutonium available in a form suitable for use as reactor fuel. The Commission emphasized that its refusal to cut back the scope of the fuel cycle rulemaking is not to be allowed to convert this rulemaking into a GESMO proceeding."

The staff based its reprocessing impact estimates on performance predictions for future facilities rather than on the NFS operation. The staff's model reprocessing facility is intended to be representative of the as-yet-unoperated Allied Gulf Nuclear Service Plant at Barnwell, South Carolina, built with a capacity of 5 metric tons/day, and Exxon Nuclear's proposed Nuclear Fuel Recovery and Recycling Center, designed for an ultimate capacity of 7 metric tons/day. The staff assumed that the model facility would operate with a capacity factor of 0.8 and would reprocess spent fuel from 57 model reactors.[30] The staff assumed that effluent control measures proposed for the model facility would achieve for several radioactive effluents a degree of decontamination greatly exceeding that demonstrated at NFS.[31]

The Hearing Board found that equipment was presently available or reasonably likely to be developed that would enable operation of a reprocessing facility on the scale assumed by the staff. The Board noted that design improvements intended to overcome operational difficulties experienced at NFS have been incorporated in Barnwell and that in any case no problems identified in the record appeared too difficult for solution by sound engineering and additional experience. The Board found that the capacity factor of 0.8 assumed by the staff was probably too optimistic but that a factor of 0.7 was likely to be achieved. Even with this lower capacity factor, the Board found that because the staff had probably overestimated the amount of spent fuel discharged annually per reactor the staff's model facility would still be able

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[30] As of March 1979 there were seventy light water power reactors licensed to operate in the United States.

[31] These include ruthenium-106, strontium-90, cesium-137, plutonium and other transuranic nuclides. The staff assumed decontamination factors on the order of 10^8. Decontamination factors of about 10^5 were measured at NFS for ruthenium, strontium, and cesium. See Recommendations at 22.

to reprocess spent fuel from 57 reactors, as assumed. In any event, the Board observed, radioactive releases and natural gas consumption, which are the major reprocessing impact contributions to Table S-3, are primarily dependent on the amount of spent fuel processed per reference reactor year and are not much affected by reprocessing plant size or capacity factor.

With regard to radioactive effluents from reprocessing plants, the Board found that the impact values "are reasonable and in most instances are overestimates of the impacts that would actually occur." Recommendations at 17. The Board noted that the staff assumed spent fuel would be reprocessed after 160 days decay, while in all likelihood any spent fuel actually reprocessed in the foreseeable future will probably have been stored five years or more following removal from the reactor. In this period iodine-131 (8-day half-life) will have decayed away, ruthenium-106 (368-day half-life) will be reduced by a factor of about 30, and tritium and krypton-85 will be reduced by a factor of 1.3 or more.

The Board observed that the control measures which the staff relied on to achieve decontamination factors greatly superior to NFS experience "have not been operated in the combinations proposed, and some have been tested only in the laboratory." Recommendations at 20. Nevertheless the Board found these tests sufficiently convincing to support the staff's conclusion that the assumed decontamination factors can be achieved and probably surpassed. The low decontamination factors at NFS were, in the Board's view, largely caused by faulty design and perhaps faulty operation. The Board concluded that the staff had probably overestimated the amounts of ruthenium, non-volatile fission products and transuranic nuclides likely to be released during normal operation of a model reprocessing facility.[32]

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[32] With regard to volatile radionuclides, as noted previously (see note 20), the staff assumed all tritium, krypton-85, and carbon-14

In its comments to the Commission, the Sierra Club stressed its view that reprocessing impacts (including occupational exposures) should be based on the NFS historical experience rather than on "idealized hypothetical facilities," or alternatively that the table should be amended to include two sets of reprocessing estimates, one based on historical experience and the other on model facilities. The Sierra Club also called attention to the omission of technetium-99 releases from Table S-3 and argued that these releases would be significant.[33]

The Commission does not accept the view that historical experience should be the definitive measure for reprocessing impacts. The Commission finds that the staff and the Board were reasonable in recommending that reprocessing impact estimates take account of expected technological improvements, especially where most if not all of those improvements are not simply "hypothetical" but are already designed, constructed, and installed in an existing facility (Barnwell). As the comments pointed out, Barnwell has not operated, and there is always uncertainty whether untested facilities will work as well as planned. But even if one agrees with the observation made in several of the comments that in

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in spent fuel would be released, either in reprocessing or during the operating phase of a waste disposal repository. The Board found the release values for krypton-85 and tritium to be overestimates and the carbon-14 emission value of 24 curies to be "reasonable." The Board found that the staff had also overestimated iodine-129 releases from reprocessing, but this estimate is of no consequence since the iodine-129 value in Table S-3 is based on total releases from spent fuel during waste repository operation.

[33] Technetium-99 is a relatively volatile radionuclide with a half-life of 213,000 years. The Hearing Board found that the assumption that all iodine-129 is released "tends to compensate" for the neglect of technetium. The Board concluded also that technetium releases could probably be contained at least as well as ruthenium releases, which in the Board's view the staff had overestimated. The Board recommended that technetium release impacts be considered explicitly as part of the general update.

nuclear technology things almost never work as well as planned, it would seem that reasonable allowance for this factor is included within the staff's many conservatisms and overestimates of releases noted by the Hearing Board.

Furthermore, the Commission does not believe that including in the table a separate set of impact estimates based on NFS experience would illuminate the uncertainty issue. NFS impacts are not likely to be a meaningful measure, even as a limiting case. It is clear from the general dissatisfaction with the NFS facility that further commercial reprocessing ventures will not be attempted unless their proponents have sound reason to expect much better performance, including reduced occupational exposure.[34]

Accordingly, the Commission concludes, as in the matter of waste disposal uncertainties, that uncertainties in reprocessing impacts should be resolved within this rulemaking by adopting tabulated impacts based on model facilities using technology most likely to be employed. Except for technetium-99 releases, the Commission has therefore found that the modified Table S-3 provides an adequate treatment of reprocessing impacts. It appears from the record that technetium releases from the fuel cycle will occur but are not included in the table. The Commission believes that Table S-3 should be supplemented during the general update by inclusion

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[34] Thus the NFS facility is not representative of "existing technology" in the sense of an ongoing activity which will continue at a present level of impact until technical breakthroughs occur. The court of appeals' comment, 547 F.2d 638, note 13, noted by the Sierra Club, that it might be desirable to have alternative impact estimates, one "based only on existing technology" and another which takes account of anticipated developments, does not in the Commission's view apply to the reprocessing situation as it now exists. The court of appeals also stated that it had "no occasion in this case to decide whether a court could ever require such a procedure." *Id.*

of an appropriate value for technetium releases. Pending this supplementation, both the magnitude and the environmental significance of technetium releases from back end fuel cycle activities may be considered in individual reactor licensing proceedings which have not been noticed for hearing on environmental matters prior to the effective date of this final rule. In view of the Hearing Board's conclusion that the conservative assumption of complete release of iodine-129 tends to compensate for the omission of technetium from Table S-3, the Commission finds it unnecessary to reopen closed proceedings or to disturb consideration of environmental issues in presently pending proceedings to provide for consideration of technetium-99 releases.

2. The Explanatory Narrative.

As the comments indicate, this rulemaking grew well beyond a narrow inquiry into the evidentiary basis supporting the numbers tabulated in the interim rule. The broader perspective taken by the participants and the Hearing Board has helped clarify many aspects of fuel cycle environmental impacts not covered by Table S-3 which need to be addressed, at least conceptually, in a comprehensive fuel cycle rule. Until such a rule is developed important generic fuel cycle issues must continue to be litigated in individual reactor licensing proceedings. These issues include—but are not necessarily limited to—environmental dose commitments and health effects from fuel cycle releases, fuel cycle socioeconomic impacts, and possible cumulative impacts. Pending further treatment by rulemaking, the NRC staff is directed to address these matters in the environmental analysis accompanying a proposal to issue a limited work authorization, construction permit, or operating license for a power reactor.

The Commission has accepted the Hearing Board's recommendation that an explanatory narrative which ad-

dresses these subjects should be prepared and adopted as part of the fuel cycle rule. Although such a narrative is not legally required, provided an adequate description of fuel cycle impacts is given in individual proceedings, the same reasons which favor treatment of fuel cycle impacts by generic rulemaking also favor evaluating the significance of those impacts by rulemaking, rather than by repeated adjudication. The Commission agrees, however, that adoption of a narrative by rulemaking will require adequate notice and opportunity for public comment and therefore cannot be done without a further proceeding. Since the narrative must address important basic issues in arriving at a method for evaluating the significance of fuel cycle impacts,[35] the Commission has determined that such a proceeding should begin promptly.

The Commission has directed the staff to prepare by October 1, 1979, a draft narrative for the Commission's review prior to issuance for public comment.

Pursuant to the Atomic Energy Act of 1954, as amended, the Energy Reorganization Act of 1974, as amended, the National Environmental Policy Act of 1969, as amended, and sections 552 and 553 of Title 5 of the United States Code, the following amendment to 10 CFR Part 51 is published as a document subject to codification, to be effective on September 4, 1979.

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[35] Among these issues is the question of the time period over which dose commitments from long-lived radioactive effluents should be evaluated. The court of appeals observed with regard to waste disposal that: "[T]he toxic life of the waste under discussion far exceeds the life of the plant being licensed. The environmental effects to be considered are those flowing from reprocessing and passive storage for the full detoxification period." 547 F.2d 639, note 12. The analysis required by NEPA is, of course, subject to a rule of reason. *See Vermont Yankee Nuclear Power Corp. v. NRDC, 435 U.S. 519, 551 (1978); NRDC v. Morton, 458 F.2d 827, 837 (D.C. Cir. 1972).* How dose commitment evaluations over extended periods of time might be performed and what their significance might be are subjects which the Commission expects an explanatory narrative would address.

10 CFR Part 51 is amended by revising § 51.20(e) and 51.23(c) as follows:

§ 51.20 Applicant's Environmental Report—Construction Permit Stage.

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(e) The Environmental Report required by paragraph (a) for light-water-cooled nuclear power reactors shall take Table S-3, Table of Uranium Fuel Cycle Environmental Data, as the basis for evaluating the contribution of the environmental effects of uranium mining and milling, the production of uranium hexafluoride, isotopic enrichment, fuel fabrication, reprocessing of irradiated fuel, transportation of radioactive materials and management of low level wastes and high level wastes related to uranium fuel cycle activities to the environmental costs of licensing the nuclear power reactor. Table S-3 shall be included in the Report and may be supplemented by a discussion of the environmental significance of the data set forth in the Table as weighed in the cost-benefit analysis for the proposed facility. This paragraph applies to any applicant's environmental report submitted on September 4, 1979, or thereafter.

§ 51.23 Contents of Draft Environmental Statement.

* * * * *

(c) The draft environmental impact statement will include a preliminary cost-benefit analysis which considers and balances the environmental and other effects of the facility and the alternatives available for reducing or avoiding adverse environmental and other effects, as well as the environmental, economic, technical and other benefits of the facility. The contribution of the environmental effects of the uranium fuel cycle activities specified in § 51.20(e) shall be evaluated on the basis of impact values set forth in Table S-3, Table of Uranium Fuel Cycle Environmental Data, which shall be set out in the draft environmental impact statement. With the

exception of radon-222 and technetium-99 releases, no further discussion of fuel cycle release values and other numerical data that appear explicitly in the Table shall be required.[36] The impact statement shall take account of dose commitments and health effects from fuel cycle effluents set forth in Table S-3 and shall in addition take account of economic, socioeconomic, and possible cumulative impacts and such other fuel cycle impacts as may reasonably appear significant. The cost benefit analysis will, to the fullest extent practicable, quantify the various factors considered. To the extent that such factors cannot be quantified, they will be discussed in qualitative terms. The cost-benefit analysis will indicate what other interests and consideration of Federal policy are thought to offset any adverse environmental effects of the proposed action identified pursuant to paragraph (a). Due consideration will be given to compliance of the facility construction or operation and alternative construction and operation with environmental quality standards and requirements which have been imposed by Federal, State, regional, and local agencies having responsibility for environmental protection, including applicable zoning and land-use regulations and water pollution limitations or requirements promulgated or imposed pursuant to the Federal Water Pollution Control Act. The environmental impact of the facility will be considered in the cost-benefit analysis with respect to matters covered by such standards and requirements irrespective of whether a certification or license from the appropriate authority has been obtained, including any certification obtained pursuant to section 401 of the Federal Water Pollution Control Act. While satisfaction of Commission standards and criteria

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[36] Values for releases of Rn-222 and Tc-99 are not given in the Table. The amount and significance of Rn-222 releases from the fuel cycle and Tc-99 releases from waste management or reprocessing activities shall be considered in the draft environmental impact statement and may be the subject of litigation in individual licensing proceedings.

pertaining to radiological effects will be necessary to meet the licensing requirements of the Atomic Energy Act, the cost-benefit analysis will, for the purposes of NEPA, consider the radiological effects of the facility and alternatives.

TABLE S-3

Table of Uranium Fuel Cycle Environmental Data [1]
(Normalized to model LWR annual fuel requirement [WASH-1248] or reference reactor year [NUREG-0116])

Environmental considerations	Total	Maximum effect per annual fuel requirement or reference reactor year of model 1,000 MWe LWR
NATURAL RESOURCES USE		
Land (acres):		
Temporarily committed [2]	100	
Undisturbed area	79	
Disturbed area	22	Equivalent to a 110 MWe coal-fired power plant.
Permanently committed	13	
Overburden moved (millions of MT)	2.8	Equivalent to 95 MWe coal-fired power plant.
Water (millions of gallons):		
Discharged to air	160	= 2 percent of model 1,000 MWe LWR with cooling tower.
Discharged to water bodies	11,090	
Discharged to ground	127	
Total	11,377	< 4 percent of model 1,000 MWe LWR with once-through cooling.
Fossil fuel:		
Electrical energy (thousands of MW-hour)	323	< 5 percent of model 1,000 MWe LWR output.
Equivalent coal (thousands of MT)	118	Equivalent to the consumption of a 45 MWe coal-fired power plant.
Natural gas (millions of scf)	135	< 0.4 percent of model 1.000 MWe energy output.
EFFLUENTS—CHEMICAL (MT)		
Gases (including entrainment): [3]		
SO_x	4,400	
NO_x [4]	1,190	
Hydrocarbons	14	Equivalent to emissions from 45 MWe coal-fired plant for a year.
CO	29.6	
Particulates	1,154	

Table S-3—Continued

Environmental considerations	Total	Maximum effect per annual fuel requirement or reference reactor year of model 1,000 MWe LWR
Other gases:		
F	.67	Principally from UF_6 production, enrichment, and reprocessing. Concentration within range of state standards—below level that has effects on human health.
HCl	.014	
Liquids:		
SO_4^-	9.9	From enrichment, fuel fabrication, and reprocessing steps. Components that constitute a potential for adverse environmental effect are present in dilute concentrations and receive additional dilution by receiving bodies of water to levels below permissible standards. The constituents that require dilution and the flow of dilution water are: NH_3—600 cfs. NO_3—20 cfs. Fluoride—70 cfs.
NO_3^-	25.8	
Fluoride	12.9	
Ca^{++}	5.4	
Cl^-	8.5	
Na^+	12.1	
NH_3	10.0	
Fe	.4	
Tailings solutions (thousands of MT)	240	From mills only—no significant effluents to environment.
Solids	91,000	Principally from mills—no significant effients to environment.
EFFLUENTS—RADIOLOGICAL (CURIES)		
Gases (including entrainment):		
Rn-222		Presently under reconsideration by the Commission.
Ra-226	.02	
Th-230	.02	
Uranium	.034	
Tritium (thousands)	18.1	
C-14	24	
Kr-85 (thousands)	400	
Ru-106	.14	Principally from fuel reprocessing plants.
I-129	1.3	
I-131	.83	
Tc-99		Presently under consideration by the Commission.
Fission products and transuranics	203	

Table S-3—Continued

Environmental considerations	Total	Maximum effect per annual fuel requirement or reference reactor year of model 1,000 MWe LWR
Liquids:		
Uranium and daughters	2.1	Principally from milling—included tailings liquor and returned to ground—no effluents; therefore, no effect on environment.
Ra-226	.0034	From UF_6 production.
Th-230	.0015	
Th-234	.01	From fuel fabrication plants—concentration 10 percent of 10 CFR 20 for total processing 26 annual fuel requirements for model LWR.
Fission and activation products	5.9×10^{-6}	
Solids (buried on site):		
Other than high level (shallow)	11,300	9,100 Ci comes from low level reactor wastes and 1,500 Ci comes from reactor decontamination and decommissioning—buried at land burial facilities. 600 Ci comes from mills—included in tailings returned to ground.
TRU and HLW (deep)	1.1×10^{7}	Buried at Federal Repository.
Effluents—thermal (billions of British thermal units)	4,063	<5 percent of model 1,000 MWe LWR.
Transportation (person-rem):		
Exposure of workers and general public	2.5	
Occupational exposure (person-rem)	22.6	From reprocessing and waste management.

[1] In some cases where no entry appears it is clear from the background documents that the matter was addressed and that, in effect, the Table should be read as if a specific zero entry had been made. However, there are other areas that are not addressed at all in the Table. Table S-3 does not include health effects from the effluents described in the Table, or estimates of releases of Radon-222 from the uranium fuel cycle or estimates of Technetium-99 released from waste management or reprocessing activities. These issues may be the subject of litigation in the individual licensing proceedings.

Data supporting this table are given in the "Environmental Survey of the Uranium Fuel Cycle," WASH-1248, April 1974; the "Environmental Survey of the Reprocessing and Waste Management Portion of the LWR Fuel Cycle," NUREG-0116 (Supp. 1 to WASH-1248); the "Public Comments and Task Force Responses Regarding the Environmental Survey of the Reprocessing and Waste Management Portions of the LWR Fuel Cycle," NUREG-0216 (Supp. 2 to WASH-1248); and in the record of the final rulemaking pertain-

ing to Uranium Fuel Cycle Impacts from Spent Fuel Reprocessing and Radioactive. Waste Management, Docket RM-50-3. The contributions from reprocessing, waste management and transportation of wastes are maximized for either of the two fuel cycles (uranium only and no recycle). The contribution from transportation excludes transportation of cold fuel to a reactor and of irradiated fuel and radioactive wastes from a reactor which are considered in Table S-4 of § 51.20(g). The contributions from the other steps of the fuel cycle are given in columns A-E of Table 3-A of WASH-1248.

[2] The contributions to temporarily committed land from reprocessing are not prorated over 30 years, since the complete temporary impact accrues regardless of whether the plant services one reactor for one year or 57 reactors for 30 years.

[3] Estimated effluents based upon combustion of equivalent coal for power generation.

[4] 1.2 percent from natural gas use and process.

It is so ordered.

For the Commission.

Samuel J. Chilk,

Secretary of the Commission.

Dated at Washington, D.C. this 27th day of July, 1979.

SEPARATE VIEWS OF COMMISSIONER BRADFORD ON S-3

I

I am concurring in the latest version of the S-3 table with the understanding that it is to be extensively supplemented. Today's decision does improve somewhat on the present interim version. However, it remains a document with four weaknesses that will have to be improved through the promised narrative and update proceeding. The weaknesses are the zero release repository judgment, the reprocessing scenario, the procedural underpinning, and the absence of a clear statement of the health effects and time commitments involved. Additionally, I do not agree with the ambiguous and pointless restriction on the litigation of the technetium issue and would prefer to handle it as was agreed to by four Commissioners on May 3, 1979.

I can concur in the "zero release" number only because it is better founded than the same figure in the present interim version, and because, as the Commission states, this assumption does not appear to affect the S-3 table's overall conservatism. Nonetheless, there are uncertainties here, and the Board's summary of the record has not done them justice.[1] The forthcoming narrative will, in my view, need to address this subject.

Furthermore, I think that the Commission goes too far in terming its assumption that a "bedded salt repository or its equivalent will be found" to be a "judgment." I think that litle more can be said by a prudent regulatory agency at this time in the face of this record and the general uncertainty than that the direction of current federal programs makes a bedded salt repository a responsible working assumption for NEPA purposes. That is really all that I think the staff testimony supports.[2]

More seriously, I continue to disassociate myself from the optimistic assessment of the waste management program cited by the majority that is in 42 Fed. Reg. 34391.[3] In July 1977, the Commission reached a sweeping conclusion on the sufficiency of what then passed for a waste management program without benefit even of a notice and comment proceeding, never mind a formal review. For this Statement of Considerations to reference that denial of a requested rulemaking as an expression of a Commission view on the safety of a waste repository proceeding is procedural farce of a low order.

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[1] See for example, Transcript, p. 729. The Commission improves upon the Board's understatement in its Footnote 24, p. 40. However, the IRG report itself at that point contains a dissenting view from members who felt that insufficient attention was given to "significant gaps and uncertainties in our current technical understanding."

[2] Transcript, p. 534, 575.

[3] Memorandum and Order, p. 41.

It should not be done here, especially in light of the commitment to a new generic proceeding.

As to reprocessing, I have concluded that Commissioner Gilinsky was in many respects correct in his dissenting views from our January 26, 1978 Memorandum on the scope of this rulemaking. Nevertheless, the record has now been built on what may be an unlikely case, and it seems to me the Commission's decision so circumscribes it that the worst harms foreseen by Commissioner Gilinsky cannot result from any responsible reading of the current Statement of Considerations.

II

By memorandum of January 26, 1978, to the Fuel Cycle Rulemaking Hearing Board, the Commission ordered that the Board entertain requests for cross-examination of particular witnesses on specific factual issues where a showing could be made with particularity that this procedure was necessary for an adequate record. While the Commission left the decisions on cross-examination to the sole discretion of the Hearing Board, it expected that the Hearing Board would apply the procedures in "a sensitive and careful fashion so as to assure the ventilation and consideration of waste management issues called for in *NRDC v. NRC*, 547 F.2d 633 (D.C. Cir. 1976)." I dissented from the extraordinary discretion delegated to the Board and the restrictive criteria for cross-examination.

The Board was neither sensitive nor careful in its decision to deny all cross-examination. Rather than assuring the ventilation and consideration of waste management and disposal issues, the Board stifled full exploration of crucial and difficult subjects even when the staff, to its credit, did not object.

The denial of cross-examination on two particular issues serves to illustrate the consequences. The Sierra

Club sought to cross-examine several witnesses on the release of technetium from the waste management and disposal fuel cycle facilities. The Board denied the request in general terms,[4] stating that many of the matters were not involved in this proceeding or not in serious dispute. Moreover, the Board said its review indicated that each subject was "fully ventilated" through other procedures. The Commission's finding on technetium rejects these conclusions of the Board. The Commission found that technetium releases should be included in Table S-3. However, because there was not sufficient evidence in the record to derive a release figure, the Commission ordered that the issue be litigable in individual proceedings. Thus the Commission, contrary to the Board, viewed the release of technetium both as being insufficiently serious dispute and so inadequately ventilated as to require further litigation.

By avoiding a full record on technetium, the Board has shown the futility of the Commission's procedural shortcut. As I noted in my January 26, 1978 dissent, the delays caused by withholding cross-examination can far exceed the "delays" inherent in cross-examination. The issue of technetium release now may be litigated in every individual licensing proceeding. Instead of being cross-examined once, staff witnesses are potentially subject to cross-examination in many proceedings, with licensing boards, the Appeal Board, and possibly the Commission reviewing the record of each case.

The Board also refused to allow cross-examination regarding the uncertainties of bedded salt as a waste medium. This refusal was particularly unfortunate since, as noted by the petitioner for cross-examination, it came immediately after the DOE Task Force on Nuclear Waste Management stated it was "aware of scientific issues concerning the adequacy of salt as suitable geo-

[4] Memorandum and Order, May 4, 1978.

logic medium for emplacement of concentrated waste exhibiting high surface temperatures." (Report of Task Force for Review of Nuclear Waste Management, U.S. DOE at 9, February 1978).

One of the issues on which NRDC requested cross-examination was the staff's lack of analysis of media other than salt. Now, without this inquiry, the Commission makes a "judgment" that an "equivalent" to a bedded salt repository will be found. This statement rests on some statements from the IRG Report, issued after the hearing was over.[5] Thus the Commission has, through the dubious procedural device of its "irrevocable delegation," treated a subordinate board like a distant and separate part of the government and has thereby cost itself any chance to correct the weakness of the record.

In refusing to permit cross-examination on waste disposal, the Board has kept perfect the past record of the Commission's obsessive need not to know about the uncertainties regarding its waste disposal assumptions. While continuing to express "confidence" that the wastes can and will be disposed of safely and while judging that a bedded salt repository or its equivalent will be found which will have a zero release after it is sealed, the Commission has never allowed a proceeding to take place where witnesses supporting these views could be cross-examined.

While this approach has been found by courts not to be inconsistent with Congressional intent, it is inconsistent with an accurate appraisal of the consequences of new licensing actions. I would rather that this agency had looked less for the legally acceptable minimum procedures and more for a process that gave the Commission and ultimately the public the most accurate possible

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[5] Report to the President by the Interagency Review Group on Waste Management, TID-29442, March 1979.

conception of the environmental commitments being made on its behalf.

SEPARATE VIEWS OF COMMISSIONER GILINSKY ON FINAL ADOPTION OF THE S-3 RULE

In February the Commission decided to go forward with a final table of nuclear fuel cycle environmental impacts (S-3) without waiting for the narrative explanation which it directed the NRC staff to prepare to accompany the table. Without such an explanation of the effluent release values in terms of radiological dose commitments and associated health effects, there is not much use a licensing board can make of the table in deciding whether or not to approve a license. The new table is in fact almost identical to the interim table in use now. The major effect of adopting a final rule now without an explanatory narrative is to relieve pressure for the narrative's preparation. To avoid this result I earlier urged the Commission to hold up promulgation of a final rule until the narrative is available and approved by the Commission.

At issue is each reactor's share of effluent releases from the operation of the overall nuclear fuel cycle. But the table values do not depend on the characteristics of the specific powerplant that is the subject of a licensing proceeding—they do not distinguish among reactors. As a consequence, it is virtually inconceivable that the table would affect the outcome of any such licensing proceeding before one of our boards. A finding that the reactor's share of the fuel cycle effluents outweighs the benefits of the plant in terms of the electric power it delivers is tantamount to a conclusion that no reactor should be licensed.[1] As a practical matter, such a finding, reaching the very core of NRC decisionmaking could—and should

[1] The notion that the fuel cycle effluents add to one side of the "NEPA balance" and thus might tip it in some cases and not in others in naive.

—come only from the Commission itself. If there is doubt about the outcome of this question the Commission should address it directly. By not addressing it and by dealing instead with the fuel cycle environmental impacts in reactor licensing licensing proceedings by handing the licensing boards a table of effluent releases the Commission is in effect saying that these impacts should not affect the outcome. That may in fact be the right conclusion; but if it is, the Commission should state it clearly and not hide behind a table of numbers.

There is another reason for my disagreement with the Commission's action in approving the final rule. I would not adopt at least one of the values in the table—the zero expected release from a high level waste repository. I am concerned that the Commission's expressed confidence in the *perfect* long term operation of such a waste depository may be misplaced, especially in view of its being based on a general examination by the Board in this proceeding of the bedded salt repository concept.

In this regard, I note that the D.C. Circuit Court of Appeals in *Minnesota* v. *NRC* has remanded to the Commission the question of whether there is reasonable assurance that wastes can be disposed of safely and at what point in time disposal can reasonably be effected. I think that the generic proceeding which the Commission plans to conduct in response to the D.C. Circuit's decision will give us an appropriate vehicle for a thoroughgoing evaluation of the problems involved in the government's commitment to a waste disposal solution and the likelihood that such a program is not only feasible but is also on course.

No such repository has yet operated. The prospective constructors of such a repository have not yet agreed on a design or even chosen a geologic medium. It seems anomalous, at this stage, for the regulators to express more confidence on this score than the repository designers and builders themselves have expressed.

I would add two brief comments. I previously argued that there was no need to include in this analysis an option for reprocessing, especially the contrived reprocessing mode which was considered in this hearing. The inclusion of this option has indeed complicated and lengthened the proceeding.

Also, I have come to agree with Commissioner Bradford that the Commission should not have delegated to the S-3 Hearing Board the discretion to make final determinations on whether or not to allow cross-examination on issues arising in the course of the proceeding.

[FR Doc. 79-23868 Filed 8-1-79; 8:45 a.m.]

ADMINISTRATIVE PROCEDURE ACT

* * * *

§ 553. Rule making

(a) This section applies, according to the provisions thereof, except to the extent that there is involved—

(1) a military or foreign affairs function of the United States; or

(2) a matter relating to agency management or personnel or to public property, loans, grants, benefits, or contracts.

(b) General notice of proposed rule making shall be published in the Federal Register, unless persons subject thereto are named and either personally served or otherwise have actual notice thereof in accordance with law. The notice shall include—

(1) a statement of the time, place, and nature of public rule making proceedings;

(2) reference to the legal authority under which the rule is proposed; and

(3) either the terms or substance of the proposed rule or a description of the subjects and issues involved.

Except when notice or hearing is required by statute, this subsection does not apply—

(A) to interpretative rules, general statements of policy, or rules of agency organization, procedure, or practice; or

(B) when the agency for good cause finds (and incorporates the finding and a brief statement of reasons therefor in the rules issued) that notice and public procedure thereon are impracticable, unnecessary, or contrary to the public interest.

(c) After notice required by this section, the agency shall give interested persons an opportunity to participate in the rule making through submission of written data, views, or arguments with or without opportunity for oral presentation. After consideration of the relevant matter presented, the agency shall incorporate in the rules adopted a concise general statement of their basis and purpose. When rules are required by statute to be made on the record after opportunity for an agency hearing, sections 556 and 557 of this title apply instead of this subsection.

(d) The required publication or service of a substantive rule shall be made not less than 30 days before its effective date, except—

(1) a substantive rule which grants or recognizes an exemption or relieves a restriction;

(2) interpretative rules and statements of policy; or

(3) as otherwise provided by the agency for good cause found and published with the rule.

(e) Each agency shall give an interested person the right to petition for the issuance, amendment, or repeal of a rule.

(Pub. L. 89-554, Sept. 6, 1966, 80 Stat. 383.)

* * * *

§ 706. Scope of review

To the extent necessary to decision and when presented, the reviewing court shall decide all relevant questions of law, interpret constitutional and statutory provisions, and determine the meaning or applicability of the terms of an agency action. The reviewing court shall—

(1) compel agency action unlawfully withheld or unreasonably delayed; and

(2) hold unlawful and set aside agency action, findings, and conclusions found to be—

(A) arbitrary, capricious, an abuse of discretion, or otherwise not in accordance with law;

(B) contrary to constitutional right, power, privilege, or immunity;

(C) in excess of statutory jurisdiction, authority, or limitations, or short of statutory right;

(D) without observance of procedure required by law;

(E) unsupported by substantial evidence in a case subject to sections 556 and 557 of this title or otherwise reviewed on the record of an agency hearing provided by statute; or

(F) unwarranted by the facts to the extent that the facts are subject to trial de novo by the reviewing court.

In making the foregoing determinations, the court shall review the whole record or those parts of it cited by a party, and due account shall be taken of the rule of prejudicial error.

(Pub. L. 89-554, Sept. 6, 1966, 80 Stat. 393.)

ATOMIC ENERGY ACT OF 1954

§ 2011. Congressional declaration of policy

Atomic energy is capable of application for peaceful as well as military purposes. It is therefore declared to be the policy of the United States that—

(a) the development, use, and control of atomic energy shall be directed so as to make the maximum contribution to the general welfare, subject at all times to the paramount objective of making the maximum contribution to the common defense and security; and

(b) the development, use, and control of atomic energy shall be directed so as to promote world peace, improve the general welfare, increase the standard of living, and strengthen free competition in private enterprise.

(Aug. 1, 1946, ch. 724, § 1, as added Aug. 30, 1954, ch. 1073, § 1, 68 Stat. 921.)

§ 2012. Congressional findings

The Congress of the United States makes the following findings concerning the development, use, and control of atomic energy:

(a) The development, utilization, and control of atomic energy for military and for all other purposes are vital to the common defense and security.

(b) Repealed. Pub. L. 88-489, § 1, Aug. 26, 1964, 78 Stat. 602.

(c) The processing and utilization of source, byproduct, and special nuclear material affect interstate and foreign commerce and must be regulated in the national interest.

(d) The processing and utilization of source, byproduct, and special nuclear material must be regulated in the national interest and in order to provide for the

common defense and security and to protect the health and safety of the public.

(e) Source and special nuclear material, production facilities, and utilization facilities are affected with the public interest, and regulation by the United States of the production and utilization of atomic energy and of the facilities used in connection therewith is necessary in the national interest to assure the common defense and security and to protect the health and safety of the public.

(f) The necessity for protection against possible interstate damage occurring from the operation of facilities for the production or utilization of source or special nuclear material places the operation of those facilities in interstate commerce for the purposes of this chapter.

(g) Funds of the United States may be provided for the development and use of atomic energy under conditions which will provide for the common defense and security and promote the general welfare.

(h) Repealed. Pub. L. 88-489, § 2, Aug. 26, 1964, 78 Stat. 602.

(i) In order to protect the public and to encourage the development of the atomic energy industry, in the interest of the general welfare and of the common defense and security, the United States may make funds available for a portion of the damages suffered by the public from nuclear incidents, and may limit the liability of those persons liable for such losses.

(Aug. 1, 1946, ch. 724, § 2, as added Aug. 30, 1954, ch. 1073, § 1, 68 Stat. 921, and amended Sept. 2, 1957, Pub. L. 85-256, § 1, 71 Stat. 576; Aug. 26, 1964, Pub. L. 88-489, §§ 1, 2, 78 Stat. 602.)

§ 2013. Purpose of chapter

It is the purpose of this chapter to effectuate the policies set forth above by providing for—

(a) a program of conducting, assisting, and fostering research and development in order to encourage maximum scientific and industrial progress;

(b) a program for the dissemination of unclassified scientific and technical information and for the control, dissemination, and declassification of Restricted Data, subject to appropriate safeguards, so as to encourage scientific and industrial progress;

(c) a program for Government control of the possession, use, and production of atomic energy and special nuclear material, whether owned by the Government or others, so directed as to make the maximum contribution to the common defense and security and the national welfare, and to provide continued assurance of the Government's ability to enter into and enforce agreements with nations or groups of nations for the control of special nuclear materials and atomic weapons;

(d) a program to encourage widespread participation in the development and utilization of atomic energy for peaceful purposes to the maximum extent consistent with the common defense and security and with the health and safety of the public;

(e) a program of international cooperation to promote the common defense and security and to make available to cooperating nations the benefits of peaceful applications of atomic energy as widely as expanding technology and considerations of the common defense and security will permit; and

(f) a program of administration which will be consistent with the foregoing policies and programs, with international arrangements, and with agreements for cooperation, which will enable the Congress to be currently informed so as to take further legislative action as may be appropriate.

(Aug. 1, 1946, ch. 724, § 3, as added Aug. 30, 1954, ch. 1073, § 1, 68 Stat. 922, and amended Aug. 26, 1964, Pub. L. 88-489, § 3, 78 Stat. 602.)

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§ 2131. License required

It shall be unlawful, except as provided in section 2121 of this title, for any person within the United States to transfer or receive in interstate commerce, manufacture, produce, transfer, acquire, possess, use, import, or export any utilization or production facility except under and in accordance with a license issued by the Commission pursuant to section 2133 or 2134 of this title.

(Aug. 1, 1946, ch. 724, § 101, as added Aug. 30, 1954, ch. 1073, § 1, 68 Stat. 936, and amended Aug. 6, 1956, ch. 1015, § 11, 70 Stat. 1071.)

§ 2132. Utilization and production facilities for industrial or commercial purposes

(a) Issuance of licenses

Except as provided in subsections (b) and (c) of this section, or otherwise specifically authorized by law, any license hereafter issued for a utilization or production facility for industrial or commercial purposes shall be issued pursuant to section 2133 of this title.

(b) Facilities constructed or operated under section 2134(b)

Any license hereafter issued for a utilization or production facility for industrial or commercial purposes, the construction or operation of which was licensed pursuant to section 2134(b) of this title prior to enactment into law of this subsection, shall be issued under section 2134(b) of this title.

(c) Cooperative Power Reactor Demonstration facilities

Any license for a utilization or production facility for industrial or commercial purposes constructed or operated

under an arrangement with the Commission entered into under the Cooperative Power Reactor Demonstration Program shall, except as otherwise specifically required by applicable law, be issued under section 2134(b) of this title.

(Aug. 1, 1946, ch. 724, § 102, as added Aug. 30, 1954, ch. 1073, § 1, 68 Stat. 936, and amended Dec. 19, 1970, Pub. L. 91-560, § 3, 84 Stat. 1472.)

§ 2133. Commercial licenses

(a) Conditions

The Commission is authorized to issue licenses to persons applying therefor to transfer or receive in interstate commerce, manufacture, produce, transfer, acquire, possess, use, import, or export under the terms of an agreement for cooperation arranged pusuant to section 2153 of this title, utilization or production facilities for industrial or commercial purposes. Such licenses shall be issued in accordance with the provisions of subchapter XV of this chapter and subject to such conditions as the Commission may by rule or regulation establish to effectuate the purposes and provisions of this chapter.

(b) Nonexclusive basis

The Commission shall issue such licenses on a nonexclusive basis to persons applying therefor (1) whose proposed activities will serve a useful purpose proportionate to the quantities of special nuclear material or source material to be utilized; (2) who are equipped to observe and who agree to observe such safety standards to protect health and to minimize danger to life or property as the Commission may by rule establish; and (3) who agree to make available to the Commission such technical information and data concerning activities under such licenses as the Commission may determine necessary to promote the common defense and security and to protect the health and safety of the public. All such information may be used by the Commission only for the purposes of the com-

mon defense and security and to protect the health and safety of the public.

(c) License period

Each such license shall be used for a specified period, as determined by the Commission, depending on the type of activity to be licensed, but not exceeding forty years, and may be renewed upon the expiration of such period.

(d) Limitations

No license under this section may be given to any person for activities which are not under or within the jurisdiction of the United States, except for the export of production or utilization facilities under terms of an agreement for cooperation arranged pursuant to section 2153 of this title, or except under the provisions of section 2139 of this title. No license may be issued to an alien or any [1] corporation or other entity if the Commission knows or has reason to believe it is owned, controlled, or dominated by an alien, a foreign corporation, or a foreign government. In any event, no license may be issued to any person within the United States if, in the opinion of the Commission, the issuance of a license to such person would be inimical to the common defense and security or to the health and safety of the public.

(Aug. 1, 1946, ch. 724, § 103, as added Aug. 30, 1954, ch. 1073, § 1, 68 Stat. 936, and amended Aug. 6, 1956, ch. 1015, §§ 12, 13, 70 Stat. 1071; Dec. 19, 1970, Pub. L. 91-560, § 4, 84 Stat. 1472.)

* * * * *

§ 2201. General duties of Commission

In the performance of its functions the Commission is authorized to—

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[1] So in original.

(a) Establishment of advisory boards

establish advisory boards to advise with and make recommendations to the Commission on legislation, policies, administration, research, and other matters, provided that the Commission issues regulations setting forth the scope, procedure, and limitations of the authority of each such board;

(b) Standards governing use and possession of material

establish by rule, regulation, or order, such standards and instructions to govern the possession and use of special nuclear material, source material, and byproduct material as the Commission may deem necessary or desirable to promote the common defense and security or to protect health or to minimize danger to life or property;

(c) Studies and investigations

make such studies and investigations, obtain such information, and hold such meetings or hearings as the Commission may deem necessary or proper to assist it in exercising any authority provided in this chapter, or in the administration or enforcement of this chapter, or any regulations or orders issued thereunder. For such purposes the Commission is authorized to administer oaths and affirmations, and by subpena to require any person to appear and testify, or to appear and produce documents, or both, at any designated place. Witnesses subpenaed under this subsection shall be paid the same fees and mileage as are paid witnesses in the district courts of the United States;

(d) Employment of personnel

appoint and fix the compensation of such officers and employees as may be necessary to carry out the functions of the Commission. Such officers and employees shall be appointed in accordance with the

civil-service laws and their compensation fixed in accordance with chapter 51 and subchapter III of chapter 53 of title 5, except that, to the extent the Commission deems such action necessary to the discharge of its responsibilities, personnel may be employed and their compensation fixed without regard to such laws: *Provided, however,* That no officer or employee (except such officers and employees whose compensation is fixed by law, and scientific and technical personnel up to a limit of the highest rate of grade 18 of the General Schedule) whose position would be subject to chapter 51 and subchapter III of chapter 53 of title 5, if such provisions were applicable to such position, shall be paid a salary at a rate in excess of the rate payable under such provisions for positions of equivalent difficulty or responsibility. Such rates of compensation may be adopted by the Commission as may be authorized by chapter 51 and subchapter III of chapter 53 of title 5, as of the same date such rates are authorized for positions subject to such provisions. The Commission shall make adequate provision for administrative review of any determination to dismiss any employee;

(e) Acquisition of material, property, etc.; negotiation of commercial leases

acquire such material, property, equipment, and facilities, establish or construct such buildings and facilities, and modify such buildings and facilities from time to time, as it may deem necessary, and construct, acquire, provide, or arrange for such facilities and services (at project sites where such facilities and services are not available) for the housing, health, safety, welfare, and recreation of personnel employed by the Commission as it may deem necessary, subject to the provisions of section 2224 of this title: *Provided, however,* That in the communities owned by the Commission, the Commission

is authorized to grant privileges, leases and permits upon adjusted terms which (at the time of the initial grant of any privilege grant, lease, or permit, or renewal thereof, or in order to avoid inequities or undue hardship prior to the sale by the United States of property affected by such grant) are fair and reasonable to responsible persons to operate commercial businesses without advertising and without advertising [1] and without securing competitive bi... but taking into consideration, in addition to the price, and among other things (1) the quality and type of services required by the residents of the community, (2) the experience of each concession applicant in the community and its surrounding area, (3) the ability of the concession applicant to meet the needs of the community, and (4) the contribution the concession applicant has made or will make to the other activities and general welfare of the community;

(f) Utilization of other Federal agencies

with the consent of the agency concerned, utilize or employ the services or personnel of any Government agency or any State or local government, or voluntary or uncompensated personnel, to perform such functions on its behalf as may appear desirable;

(g) Acquisition of real and personal property

acquire, purchase, lease, and hold real and personal property, including patents, as agent of and on behalf of the United States, subject to the provisions of section 2224 of this title, and to sell, lease, grant, and dispose of such real and personal property as provided in this chapter;

(h) Consideration of license applications

consider in a single application one or more of the activities for which a license is required by this

[1] So in original.

chapter, combine in a single license one or more of such activities, and permit the applicant or licensee to incorporate by reference pertinent information already filed with the Commission;

(i) Regulations governing Restricted Data

prescribe such regulations or orders as it may deem necessary (1) to protect Restricted Data received by any person in connection with any activity authorized pursuant to this chapter, (2) to guard against the loss or diversion of any special nuclear material acquired by any person pursuant to section 2073 of this title or produced by any person in connection with any activity authorized pursuant to this chapter, to prevent any use or disposition thereof which the Commission may determine to be inimical to the common defense and security, including regulations or orders designating activities, involving quantities of special nuclear material which in the opinion of the Commission are important to the common defense and security, that may be conducted only by persons whose character, associations, and loyalty shall have been investigated under standards and specifications established by the Commission and as to whom the Commission shall have determined that permitting each such person to conduct the activity will not be inimical to the common defense and security, and (3) to govern any activity authorized pursuant to this chapter, including standards and restrictions governing the design, location, and operation of facilities used in the conduct of such activity, in order to protect health and to minimize danger to life or property;

(j) Disposition of surplus materials

without regard to the provisions of the Federal Property and Administrative Services Act of 1949, as amended [40 U.S.C. 471 et seq.], except section

207 of that Act [40 U.S.C. 488], or any other law, make such disposition as it may deem desirable of (1) radioactive materials, and (2) any other property, the special disposition of which is, in the opinion of the Commission, in the interest of the national security: *Provided, however,* That the property furnished to licensees in accordance with the provisions of subsection (m) of this section shall not be deemed to be property disposed of by the Commission pursuant to this subsection;

(k) Carrying of firearms

authorize such of its members, officers, and employees as it deems necessary in the interest of the common defense and security to carry firearms while in the discharge of their official duties. The Commission may also authorize such of those employees of its contractors engaged in the protection of property owned by the United States and located at facilities owned by or contracted to the United States as it deems necessary in the interests of the common defense and security to carry firearms while in the discharge of their official duties;

(*l*) Repealed. Pub. L. 87-456, title III, § 303(c), May 24, 1962, 76 Stat. 78

(m) Agreements regarding production

enter into agreements with persons licensed under section 2133, 2134, 2073(a)(4), or 2093(a)(4) of this title for such periods of time as the Commission may deem necessary or desirable (1) to provide for the processing, fabricating, separating, or refining in facilities owned by the Commission of source, by-product, or other material or special nuclear material owned by or made available to such licensees and which is utilized or produced in the conduct of the licensed activity, and (2) to sell, lease, or otherwise make available to such licensees such quantities of

source or by-product material, and other material not defined as special nuclear material pursuant to this chapter, as may be necessary for the conduct of the licensed activity: *Provided, however,* That any such agreement may be canceled by the licensee at any time upon payment of such reasonable cancellation charges as may be agreed upon by the licensee and the Commission: *And provided further,* That the Commission shall establish prices to be paid by licensees for material or services to be furnished by the Commission pursuant to this subsection, which prices shall be established on such a nondiscriminatory basis as, in the opinion of the Commission, will provide reasonable compensation to the Government for such material or services and will not discourage the development of sources of supply independent of the Commission;

(n) Delegation of functions

delegate to the General Manager or other officers of the Commission any of those functions assigned to it under this chapter except those specified in sections 2071, 2077(b), 2091, 2138, 2153, 2165(b) of this title (with respect to the determination of those persons to whom the Commission may reveal Restricted Data in the national interest), 2165(f) of this title and subsection (a) of this section;

(o) Reports

require by rule, regulation, or order, such reports, and the keeping of such records with respect to, and to provide for such inspections of, activities and studies of types specified in section 2051 of this title and of activities under licenses issued pursuant to sections 2073, 2093, 2111, 2133, and 2134 of this title, as may be necessary to effectuate the purposes of this chapter, including section 2135 of this title; and

(p) Rules and regulations

make, promulgate, issue, rescind, and amend such rules and regulations as may be necessary to carry out the purposes of this chapter.

(q) Easements for rights-of-way

The Commission is authorized and empowered, under such terms and conditions as are deemed advisable by it, to grant easements for rights-of-way over, across, in, and upon acquired lands under its jurisdiction and control, and public lands permanently withdrawn or reserved for the use of the Commission, to any State, political subdivision thereof, or municipality, or to any individual, partnership, or corporation of any State, Territory, or possession of the United States, for (a) railroad tracks; (b) oil pipe lines; (c) substations for electric power transmission lines, telephone lines, and telegraph lines, and pumping stations for gas, water, sewer, and oil pipe lines; (d) canals; (e) ditches; (f) flumes; (g) tunnels; (h) dams and reservoirs in connection with fish and wildlife programs, fish hatcheries, and other fish-cultural improvements; (i) roads and streets; and (j) for any other purpose or purposes deemed advisable by the Commission: *Provided*, That such rights-of-way shall be granted only upon a finding by the Commission that the same will not be incompatible with the public interest; *Provided further*, That such rights-of-way shall not include any more land than is reasonably necessary for the purpose for which granted: *And provided further*, That all or any part of such rights-of-way may be annulled and forfeited by the Commission for failure to comply with the terms and conditions of any grant hereunder or for nonuse for a period of two consecutive years or abandonment of rights granted under authority hereof. Copies of all instruments granting easements over public lands pursuant to this section shall be furnished to the Secretary of the Interior.

(r) Sale of utilities and related services

Under such regulations and for such periods and at such prices the Commission may prescribe, the Commission may sell or contract to sell to purchasers within Commission owned communities or in the immediate vicinity of the Commission community, as the case may be, any of the following utilities and related services, if it is determined that they are not available from another local source and that the sale is in the interest of the national defense or in the public interest:

(1) Electric power.

(2) Steam.

(3) Compressed air.

(4) Water.

(5) Sewage and garbage disposal.

(6) Natural, manufactured, or mixed gas.

(7) Ice.

(8) Mechanical refrigeration.

(9) Telephone service.

Proceeds of sales under this subsection shall be credited to the appropriation currently available for the supply of that utility or service. To meet local needs the Commission may make minor expansions and extensions of any distributing system or facility within or in the immediate vicinity of a Commission-owned community through which a utility or service is furnished under this subsection.

(8) Succession of authority

establish a plan for a succession of authority which will assure the continuity of direction of the Commission's operations in the event of a national

disaster due to enemy activity. Notwithstanding any other provision of this chapter, the person or persons succeeding to command in the event of disaster in accordance with the plan established pursuant to this subsection shall be vested with all of the authority of the Commission: *Provided*, That any such succession to authority, and vesting of authority shall be effective only in the event and as long as a quorum of three or more members of the Commission is unable to convene and exercise direction during the disaster period: *Provided further*, That the disaster period includes the period when attack on the United States is imminent and the post-attack period necessary to reestablish normal lines of command;

(t) Contracts

enter into contracts for the processing, fabricating, separating, or refining in facilities owned by the Commission of source, byproduct or other material, or special nuclear material, in accordance with and within the period of an agreement for cooperation while comparable services are available to persons licensed under section 2133 or 2134 of this title: *Provided*, That the prices for services under such contracts shall be no less than the prices currently charged by the Commission pursuant to subsection (m) of this section;

(u) Additional contracts; guiding principles; appropriations

(1) enter into contracts for such periods of time as the Commission may deem necessary or desirable, but not to exceed five years from the date of execution of the contract, for the purchase or acquisition of reactor services or services related to or required by the operation of reactors;

(2) (A) enter into contracts for such periods of time as the Commission may deem necessary or de-

sirable for the purchase or acquisition of any supplies, equipment, materials, or services required by the Commission whenever the Commission determines that: (i) it is advantageous to the Government to make such purchase or acquisition from commercial sources; (ii) the furnishing of such supplies, equipment, materials, or services will require the construction or acquisition of special facilities by the vendors or suppliers thereof; (iii) the amortization chargeable to the Commission constitutes an appreciable portion of the cost of contract performance, excluding cost of materials; and (iv) the contract for such period is more advantageous to the Government than a similar contract not executed under the authority of this subsection. Such contracts shall be entered into for periods not to exceed five years each from the date of initial delivery of such supplies, equipment, materials, or services or ten years from the date of execution of the contracts excluding periods of renewal under option.

(B) In entering into such contracts the Commission shall be guided by the following principles; (i) the percentage of the total cost of special facilities devoted to contract performance and chargeable to the Commission should not exceed the ratio between the period of contract deliveries and the anticipated useful life of such special facilities; (ii) the desirability of obtaining options to renew the contract for reasonable periods at prices not to include charges for special facilities already amortized; and (iii) the desirability of reserving in the Commission the right to take title to the special facilities under appropriate circumstances; and

(3) include in contracts made under this subsection provisions which limit the obligation of funds to estimated annual deliveries and services and the unamortized balance of such amounts due for special

facilities as the parties shall agree is chargeable to the performance of the contract. Any appropriation available at the time of termination or thereafter made available to the Commission for operating expenses shall be available for payment of such costs which may arise from termination as the contract may provide. The term "special facilities" as used in this subsection means any land and any depreciable buildings, structures, utilities, machinery, equipment, and fixtures necessary for the production or furnishing of such supplies, equipment, materials, or services and not available to the vendors or suppliers for the performance of the contract.

(v) Contracts for production or enrichment of special nuclear material; domestic licensees; other nations; prices; materials of foreign origin; criteria for availability of services under this subsection; Congressional review

(A) enter into contracts with persons licensed under sections 2073, 2093, 2133 or 2134 of this title for such periods of time as the Commission may deem necessary or desirable to provide, after December 31, 1968, for the producing or enriching of special nuclear material in facilities owned by the Commission; and

(B) enter into contracts to provide, after December 31, 1968, for the producing or enriching of special nuclear material in facilities owned by the Commission in accordance with and within the period of an agreement for cooperation arranged pursuant to section 2153 of this title while comparable services are made available pursuant to paragraph (A) of this subsection.

Provided, That (i) prices for services under paragraph (A) of this subsection shall be established on a nondiscriminatory basis; (ii) prices for services under paragraph (B) of this subsection shall be no less than prices under paragraph (A) of this sub-

section; and (iii) any prices established under this subsection shall be on a basis of recovery of the Government's costs over a reasonable period of time: *And provided further*, That the Commission, to the extent necessary to assure the maintenance of a viable domestic uranium industry, shall not offer such services for source or special nuclear materials of foreign origin intended for use in a utilization facility within or under the jurisdiction of the United States. The Commission shall establish criteria in writing setting forth the terms and conditions under which services provided under this subsection shall be made available including the extent to which such services will be made available for source or special nuclear material of foreign origin intended for use in a utilization facility within or under the jurisdiction of the United States: *Provided*, That before the Commission establishes such criteria, the proposed criteria shall be submitted to the Joint Committee, and a period of forty-five days shall elapse while Congress is in session (in computing the forty-five days there shall be excluded the days in which either House is not in session because of adjournment for more than three days) unless the Joint Committee by resolution in writing waives the conditions of, or all or any portion of, such forty-five-day period.

(w) License fees for nuclear power reactors

Prescribe and collect from any other Government agency, which applies for or is issued a license for a utilization facility designed to produce electrical or heat energy pursuant to section 2133 or 2134(b) of this title, any fee, charge, or price which it may require, in accordance with the provisions of section 483a of title 31 or any other law, of applicants for, or holders of, such licenses.

(Aug. 1, 1946, ch. 724, § 161, as added Aug. 30, 1954, ch. 1073, § 1, 68 Stat. 948, and amended July 14, 1956, ch. 608, 70 Stat. 553; Aug. 6, 1956, ch. 1015, § 4, 70

Stat. 1069; Aug. 21, 1957, Pub. L. 85-162, title II, §§ 201, 204, 71 Stat. 410; Sept. 4, 1957, Pub. L. 85-287, § 4, 71 Stat. 613; July 7, 1958, Pub. L. 85-507, § 21 (b) (1), 72 Stat. 337; Aug. 19, 1958, Pub. L. 85-681, §§ 6, 7, 72 Stat. 633; Sept. 21, 1959, Pub. L. 86-300, § 1, 73 Stat. 574; Sept. 6, 1961, Pub. L. 87-206, § 13, 75 Stat. 478; May 24, 1962, Pub. L. 87-456, title III, § 303(c), 76 Stat. 78; Aug. 29, 1962, Pub. L. 87-615, § 12, 76 Stat. 411; Oct. 11, 1962, Pub. L. 87-793, § 1001(g), 76 Stat. 864; Aug. 26, 1964, Pub. L. 88-489, § 16, 78 Stat. 606; Dec. 14, 1967, Pub. L. 90-190, § 11, 81 Stat. 578; Oct. 15, 1970, Pub. L. 91-452, title II, § 237, 84 Stat. 930; Dec. 19, 1970, Pub. L. 91-560, §§ 7, 8, 84 Stat. 1474; June 16, 1972, Pub. L. 92-314, title III, § 301, 86 Stat. 227; Aug. 17, 1974, Pub. L. 93-377, § 7, 88 Stat. 475.)

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§ 2231. Applicability of administrative procedure provisions; definitions

The provisions of subchapter II of chapter 5, and chapter 7, of title 5 shall apply to all agency action taken under this chapter, and the terms "agency" and "agency action" shall have the meaning specified in section 551 of title 5: *Provided, however,* That in the case of agency proceedings or actions which involve Restricted Data or defense information, the Commission shall provide by regulation for such parallel procedures as will effectively safeguard and prevent disclosure of Restricted Data or defense information to unauthorized persons with minimum impairment of the procedural rights which would be available if Restricted Data or defense information were not involved.

(Aug. 1, 1946, ch. 724, § 181, as added Aug. 30, 1954, ch. 1073, § 1, 68 Stat. 953.)

* * * * *

§ 2239. Hearings and judicial review

(a) In any proceeding under this chapter, for the granting, suspending, revoking, or amending of any li-

cense or construction permit, or application to transfer control, and in any proceeding for the issuance or modification of rules and regulations dealing with the activities of licensees, and in any proceeding for the payment of compensation, an award or royalties under sections 2183, 2187, 2236(c) or 2238 of this title, the Commission shall grant a hearing upon the request of any person whose interest may be affected by the proceeding, and shall admit any such person as a party to such proceeding. The Commission shall hold a hearing after thirty days' notice and publication once in the Federal Register, on each application under section 2133 or 2134(b) of this title for a construction permit for a facility, and on any application under section 2134(c) of this title for a construction permit for a testing facility. In cases where such a construction permit has been issued following the holding of such a hearing, the Commission may, in the absence of a request therefor by any person whose interest may be affected, issue an operating license or an amendment to a construction permit or an amendment to an operating license without a hearing, but upon thirty days notice and publication once in the Federal Register of its intent to do so. The Commission may dispense with such thirty days' notice and publication with respect to any application for an amendment to a construction permit or an amendment to an operating license upon a determination by the Commission that the amendment involves no significant hazards consideration.

(b) Any final order entered in any proceeding of the kind specified in subsection (a) of this section shall be subject to judicial review in the manner prescribed in chapter 158 of title 28, and to the provisions of chapter 7 of title 5.

(Aug. 1, 1946, ch. 724, § 189, as added Aug. 30, 1954, ch. 1073, § 1, 68 Stat. 955, and amended Sept. 2, 1957, Pub. L. 85-256, § 7, 71 Stat. 579; Aug. 29, 1962, Pub. L. 87-615, § 2, 76 Stat. 409.)

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ENERGY REORGANIZATION ACT OF 1974

* * * * *

§ 5801. Congressional declaration of policy and purpose

(a) Development and utilization of energy sources

The Congress hereby declares that the general welfare and the common defense and security require effective action to develop, and increase the efficiency and reliability of use of, all energy sources to meet the needs of present and future generations, to increase the productivity of the national economy and strengthen its position in regard to international trade, to make the Nation self-sufficient in energy, to advance the goals of restoring, protecting, and enhancing environmental quality, and to assure public health and safety.

(b) Necessity of establishing Energy Research and Development Administration

The Congress finds that, to best achieve these objectives, improve Government operations, and assure the coordinated and effective development of all energy sources, it is necessary to establish an Energy Research and Development Administration to bring together and direct Federal activities relating to research and development on the various sources of energy, to increase the efficiency and reliability in the use of energy, and to carry out the performance of other functions, including but not limited to the Atomic Energy Commission's military and production activities and its general basic research activities. In establishing an Energy Research and Development Administration to achieve these objectives, the Congress intends that all possible sources of energy be developed consistent with warranted priorities.

(c) Separation of licensing and regulatory functions of the Atomic Energy Commission

The Congress finds that it is in the public interest that the licensing and related regulatory functions of the

Atomic Energy Commission be separated from the performance of the other functions of the Commission, and that this separation be effected in an orderly manner, pursuant to this chapter, assuring adequacy of technical and other resources necessary for the performance of each.

(d) Small business participation

The Congress declares that it is in the public interest and the policy of Congress that small business concerns be given a reasonable opportunity to participate, insofar as is possible, fairly and equitably in grants, contracts, purchases, and other Federal activities relating to research, development, and demonstration of sources of energy efficiency, and utilization and conservation of energy. In carrying out this policy, to the extent practicable, the Administrator shall consult with the Administrator of the Small Business Administration.

(e) Priorities

Determination of priorities which are warranted should be based on such considerations as power-related values of an energy source, preservation of material resources, reduction of pollutants, export market potential (including reduction of imports), among others. On such a basis, energy sources warranting priority might include, but not be limited to, the various methods of utilizing solar energy.

(Pub. L. 93-438, § 2, Oct. 11, 1974, 88 Stat. 1233.)

* * * * *

§ 5814. Abolition and transfers

(a) Abolition of Atomic Energy Commission

The Atomic Energy Commission is hereby abolished.

(b) Transfer or lapse of function of Atomic Energy Commission

All other functions of the Commission, the Chairman and members of the Commission, and the officers and components of the Commission are hereby transferred or allowed to lapse pursuant to the provisions of this chapter.

(c) Functions of Atomic Energy Commission transferred to Administrator

There are hereby transferred to and vested in the Administrator all functions of the Atomic Energy Commission, the Chairman and members of the Commission, and the officers and components of the Commission, except as otherwise provided in this chapter.

(d) Transfer of General Advisory Committee, Patent Compensation Board, and Divisions of Military Application and Naval Reactors to Administration

The General Advisory Committee established pursuant to section 2036 of this title, the Patent Compensation Board established pursuant to section 2187 of this title, and the Divisions of Military Application and Naval Reactors established pursuant to section 2035 of this title, are transferred to the Energy Research and Development Administration and the functions of the Commission with respect thereto, and with respect to relations with the Military Liaison Committee established by section 2037 of this title, are transferred to the Administrator.

(e) Transfer to Administrator of certain functions of Secretary of the Interior and Department of the Interior; study of potential energy application of helium; report to President and Congress

There are hereby transferred to and vested in the Administrator such functions of the Secretary of the Interior, the Department of the Interior, and officers and components of such department—

(1) as relate to or are utilized by the Office of Coal Research established pursuant to the Act of July 1, 1960 (74 Stat. 336; 30 U.S.C. 661-669);

(2) as relate to or are utilized in connection with fossil fuel energy research and development programs and related activities conducted by the Bureau of Mines "energy centers" and synthane plant to provide greater efficiency in the extraction, processing, and utilization of energy resources for the purpose of conserving those resources, developing alternative energy resources, such as oil and gas secondary and tertiary recovery, oil shale and synthetic fuels, improving methods of managing energy-related wastes and pollutants, and providing technical guidance needed to establish and administer national energy policies; and

(3) as relate to or are utilized for underground electric power transmission research. The Administrator shall conduct a study of the potential energy applications of helium and, within six months from October 11, 1974, report to the President and Congress his recommendations concerning the management of the Federal helium programs, as they relate to energy.

(f) Transfer to Administrator of certain functions of National Science Foundation

There are hereby transferred to and vested in the Administrator such functions of the National Science Foundation as relate to or are utilized in connection with—

(1) solar heating and cooling development; and

(2) geothermal power development.

(g) Transfer to Administrator of certain functions of Environmental Protection Agency

There are hereby transferred to and vested in the Administrator such functions of the Environmental Protection Agency and the officers and components thereof as relate to or are utilized in connection with research, development, and demonstration, but not assessment or

monitoring for regulatory purposes, of alternative automotive power systems.

(h) Exercise of authority necessary or appropriate to perform transferred functions and carry out transferred programs

To the extent necessary or appropriate to perform functions and carry out programs transferred by this chapter, the Administrator and Commission may exercise, in relation to the functions so transferred, any authority or part thereof available by law, including appropriation Acts, to the official or agency from which such functions were transferred.

(i) Utilization of technical and management capabilities of other executive agencies; assignment of specific programs or projects in energy research and development

In the exercise of his responsibilities under section 5813 of this title, the Administrator shall utilize, with their consent, to the fullest extent he determines advisable the technical and management capabilities of other executive agencies having facilities, personnel, or other resources which can assist or advantageously be expanded to assist in carrying out such responsibilities. The Administrator shall consult with the head of each agency with respect to such facilities, personnel, or other resources, and may assign, with their consent, specific programs or projects in energy research and development as appropriate. In making such assignments under this subsection, the head of each such agency shall insure that—

(1) such assignments shall be in addition to and not detract from the basic mission responsibilities of the agency, and

(2) such assignments shall be carried out under such guidance as the Administrator deems appropriate.

(Pub. L. 93-438, title I, § 104, Oct. 11, 1974, 88 Stat. 1237.)

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§ 5841. Establishment and transfers

(a) Composition; Chairman; Acting Chairman; quorum; official spokesman; seal; functions of Chairman and Commission

(1) There is established an independent regulatory commission to be known as the Nuclear Regulatory Commission which shall be composed of five members, each of whom shall be a citizen of the United States. The President shall designate one member of the Commission as chairman thereof to serve as such during the pleasure of the President. The Chairman may from time to time designate any other member of the Commission as Acting Chairman to act in the place and stead of the Chairman during his absence. The Chairman (or the Acting Chairman in the absence of the Chairman) shall preside at all meetings of the Commission and a quorum for the transaction of business shall consist of at least three members present. Each member of the Commission, including the Chairman, shall have equal responsibility and authority in all decisions and actions of the Commission, shall have full access to all information relating to the performance of his duties or responsibilities, and shall have one vote. Action of the Commission shall be determined by a majority vote of the members present. The Chairman (or Acting Chairman in the absence of the Chairman) shall be the official spokesman of the Commission in its relations with the Congress, Government agencies, persons, or the public, and, on behalf of the Commission, shall see to the faithful execution of the policies and decisions of the Commission, and shall report thereon to the Commission from time to time or as the Commission may direct. The Commission shall have an official seal which shall be judicially noticed.

(2) The Chairman of the Commission shall be the principal executive officer of the Commission, and he shall

exercise all of the executive and administrative functions of the Commission, including functions of the Commission with respect to (a) the appointment and supervision of personnel employed under the Commission (other than personnel employed regularly and full time in the immediate offices of commissioners other than the Chairman, and except as otherwise provided in this chapter), (b) the distribution of business among such personnel and among administrative units of the Commission, and (c) the use and expenditure of funds.

(3) In carrying out any of his functions under the provisions of this section the Chairman shall be governed by general policies of the Commission and by such regulatory decisions, findings, and determinations as the Commission may by law be authorized to make.

(4) The appointment by the Chairman of the heads of major administrative units under the Commission shall be subject to the approval of the Commission.

(5) There are hereby reserved to the Commission its functions with respect to revising budget estimates and with respect to determining upon the distribution of appropriated funds according to major programs and purposes.

(b) Appointment of members

(1) Members of the Commission shall be appointed by the President, by and with the advice and consent of the Senate.

(2) Appointments of members pursuant to this subsection shall be made in such a manner that not more than three members of the Commission shall be members of the same political party.

(c) Term of office

Each member shall serve for a term of five years, each such term to commence on July 1, except that of the five

members first appointed to the Commission, one shall serve for one year, one for two years, one for three years, one for four years, and one for five years, to be designated by the President at the time of appointment; and except that any member appointed to fill a vacancy occurring prior to the expiration of the term for which his predecessor was appointed, shall be appointed for the remainder of such term. For the purpose of determining the expiration date of the terms of office of the five members first appointed to the Nuclear Regulatory Commission, each such term shall be deemed to have begun July 1, 1975.

(d) Submission of appointments to Senate

Such initial appointments shall be submitted to the Senate within sixty days of October 11, 1974. Any individual who is serving as a member of the Atomic Energy Commission on October 11, 1974, and who may be appointed by the President to the Commission, shall be appointed for a term designated by the President, but which term shall terminate not later than the end of his present term as a member of the Atomic Energy Commission, without regard to the requirements of subsection (b) (2) of this section. Any subsequent appointment of such individuals shall be subject to the provisions of this section.

(e) Removal of members; prohibition against engagement in business or other employment

Any member of the Commission may be removed by the President for inefficiency, neglect of duty, or malfeasance in office. No member of the Commission shall engage in any business, vocation, or employment other than that of serving as a member of the Commission.

(f) Transfer of licensing and regulatory functions of the Atomic Energy Commission

There are hereby transferred to the Commission all the licensing and related regulatory functions of the Atomic

Energy Commission, the Chairman and members of the Commission, the General Counsel, and other officers and components of the Commission—which functions officers, components, and personnel are excepted from the transfer to the Administrator by section 5814(c) of this title.

(g) Additional transfers

In addition to other functions and personnel transferred to the Commission, there are also transferred to the Commission—

(1) the functions of the Atomic Safety and Licensing Board Panel and the Atomic Safety and Licensing Appeal Board;

(2) such personnel as the Director of the Office of Management and Budget determines are necessary for exercising responsibilities under section 5845 of this title, relating to, research, for the purpose of confirmatory assessment relating to licensing and other regulation under the provisions of the Atomic Energy Act of 1954, as amended [42 U.S.C. 2011 et seq.], and of this chapter.

(Pub. L. 93-438, title II, § 201, Oct. 11, 1974, 88 Stat. 1242; Pub. L. 94-79, title II, §§ 201-203, Aug. 9, 1975, 89 Stat. 413, 414.)

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§ 5843. Office of Nuclear Reactor Regulation

(a) Establishment; appointment of Director

There is hereby established in the Commission an Office of Nuclear Reactor Regulation under the direction of a Director of Nuclear Reactor Regulation, who shall be appointed by the Commission, who may report directly to the Commission, as provided in section 5849 of this title, and who shall serve at the pleasure of and be removable by the Commission.

(b) Functions of Director

Subject to the provisions of this chapter, the Director of Nuclear Reactor Regulation shall perform such functions as the Commission shall delegate including:

(1) Principal licensing and regulation involving all facilities, and materials licensed under the Atomic Energy Act of 1954, as amended [42 U.S.C. 2011 et seq.], associated with the construction and operation of nuclear reactors licensed under the Atomic Energy Act of 1954, as amended;

(2) Review the safety and safeguards of all such facilities, materials, and activities, and such review functions shall include, but not be limited to—

(A) monitoring, testing and recommending upgrading of systems designed to prevent substantial health or safety hazards; and

(B) evaluating methods of transporting special nuclear and other nuclear materials and of transporting and storing high-level radioactive wastes to prevent radiation hazards to employees and the general public.

(3) Recommend research necessary for the discharge of the functions of the Commission.

(c) Responsibility for safe operation of facilities

Nothing in this section shall be construed to limit in any way the functions of the Administration relating to the safe operation of all facilities resulting from all activities within the jurisdiction of the Administration pursuant to this chapter.

(Pub. L. 93-438, title II, § 203, Oct. 11, 1974, 88 Stat. 1244.)

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§ 5844. Office of Nuclear Safety and Safeguards

(a) Establishment; appointment of Director

There is hereby established in the Commission an Office of Nuclear Material Safety and Safeguards under the direction of a Director of Nuclear Material Safety and Safeguards, who shall be appointed by the Commission, who may report directly to the Commission as provided in section 5849 of this title, and who shall serve at the pleasure of and be removable by the Commission.

(b) Functions of Director

Subject to the provisions of this chapter, the Director of Nuclear Material Safety and Safeguards shall perform such functions as the Commission shall delegate including:

(1) Principal licensing and regulation involving all facilities and materials, licensed under the Atomic Energy Act of 1954, as amended [42 U.S.C. 2011 et seq.], associated with the processing, transport, and handling of nuclear materials, including the provision and maintenance of safeguards against threats, thefts, and sabotage of such licensed facilities, and materials.

(2) Review safety and safeguards of all such facilities and materials licensed under the Atomic Energy Act of 1954, as amended, and such review shall include, but not be limited to—

(A) monitoring, testing, and recommending upgrading of internal accounting systems for special nuclear and other nuclear materials licensed under the Atomic Energy Act of 1954, as amended;

(B) developing, in consultation and coordination with the Administration, contingency plans for dealing with threats, thefts, and sabotage relating to special nuclear materials, high-level radioactive wastes and nuclear facilities resulting from all activities licensed under the Atomic Energy Act of 1954, as amended;

(C) assessing the need for, and the feasibility of, establishing a security agency within the office for the performance of the safeguards functions, and a report with recommendations on this matter shall be prepared within one year of the effective date of this chapter and promptly transmitted to the Congress by the Commission.

(3) Recommending research to enable the Commission to more effectively perform its functions.

(c) Responsibility for safeguarding special nuclear materials; high-level radioactive wastes and nuclear facilities

Nothing in this section shall be construed to limit in any way the functions of the Administration relating to the safeguarding of special nuclear materials, high-level radiocative wastes and nuclear facilities resulting from all activities within the jurisdiction of the Administration pursuant to this chapter.

(Pub. L. 93-438, title II, § 204, Oct. 11, 1974, 88 Stat. 1245.)

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§ 5871. Transitional provisions

(a) Lapse of agency or other body from which functions or programs have been transferred and positions or officers therein

Except as otherwise provided in this chapter, whenever all of the functions or programs of an agency, or other body, or any component thereof, affected by this chapter, have been transferred from that agency, or other body, or any component thereof by this chapter, the agency, or other body, or component thereof shall lapse. If any agency, or other body, or any component thereof, lapses pursuant to the preceding sentence, each position and office therein which was expressly authorized by law, or the incumbent of which was authorized to receive compensation at the rate prescribed for an office or position at level II, III, IV, or V of the Executive Schedule (5 U.S.C. 5313-5316), shall lapse.

(b) Continuation of orders, determinations, rules, etc.

All orders, determinations, rules, regulations, permits, contracts, certificates, licenses, and privileges—

(1) which have been issued, made, granted, or allowed to become effective by the President, any Federal department or agency or official thereof, or by a court of competent jurisdiction, in the performance of functions which are transferred under this chapter, and

(2) which are in effect at the time this chapter takes effect,

shall continue in effect according to their terms until modified, terminated, superseded, set aside, or revoked by the President, the Administrator, the Commission, or other authorized officials, a court of competent jurisdiction, or by operation of law.

(c) Effect of chapter on proceedings pending before Atomic Energy Commission or other department or agency

The provisions of this chapter shall not affect any proceeding pending, at the time this section takes effect, before the Atomic Energy Commission or any department or agency (or component thereof) functions of which are transferred by this chapter; but such proceedings, to the extent that they relate to functions so transferred, shall be continued. Orders shall be issued in such proceedings, appeals shall be taken therefrom, and payments shall be made pursuant to such orders, as if this chapter had not been enacted; and orders issued in any such proceedings shall continue in effect until modified, terminated, superseded, or revoked by a duly authorized official, by a court of competent jurisdiction, or by operation of law. Nothing in this subsection shall be deemed to prohibit the discontinuance or modification of any such proceeding under the same terms and conditions and to the same extent that such proceeding could have been discontinued if this chapter had not been enacted.

(d) Effect of chapter on suits commenced prior to effective date

Except as provided in subsection (f) of this section—

(1) the provisions of this chapter shall not affect suits commenced prior to the date this chapter takes effect, and

(2) in all such suits proceedings shall be had, appeals taken, and judgments rendered, in the same manner and effect as if this chapter had not been enacted.

(e) Abatement of suits, or other proceedings by or against officer, department, or agency

No suit, action, or other proceeding commenced by or against any officer in his official capacity as an officer of any department or agency, functions of which are transferred by this chapter, shall abate by reason of the enactment of this chapter. No cause of action by or against any department or agency, functions of which are transferred by this chapter, or by or against any officer thereof in his official capacity shall abate by reason of the enactment of this chapter. Causes of actions, suits, actions, or other proceedings may be asserted by or against the United States or such official as may be appropriate and, in any litigation pending when this section takes effect, the court may at any time, on its own motion or that of any party, enter any order which will give effect to the provisions of this section.

(f) Continuation of suits; substitution of parties

If, before the date on which this chapter takes effect, any department or agency, or officer thereof in his official capacity, is a party to a suit, and under this chapter any function of such department, agency, or officer is transferred to the Administrator or Commission, or any other official, then such suit shall be continued as if this chapter had not been enacted, with the Administrator or Commission, or other official, as the case may be, substituted.

(g) Judicial review of orders and actions in performance of transferred functions; statutory requirements relating to notices, hearings, action upon record, or administrative review

Final orders and actions of any official or component in the performance of functions transferred by this chapter shall be subject to judicial review to the same extent and in the same manner as if such orders or actions had been made or taken by the officer, department, agency, or instrumentality in the performance of such functions immediately preceding the effective date of this chapter. Any statutory requirements relating to notices, hearings, action upon the record, or administrative review that apply to any function transferred by this chapter shall apply to the performance of those functions by the Administrator or Commission, or any officer or component.

(h) References in other laws to department, agency, officer, or office whose functions have been transferred deemed reference to Administration, Administrator, or Commission

With respect to any functions transferred by this chapter and performed after the effective date of this chapter, reference in any other law to any department or agency, or any officer or office, the functions of which are so transferred, shall be deemed to refer to the Administration, the Administrator or Commission, or other office or official in which this chapter vests such functions.

(i) Limitation, curtailment, etc., of presidential functions or authority

Nothing contained in this chapter shall be construed to limit, curtail, abolish, or terminate any function of the President which he had immediately before the effective date of this chapter; or to limit, curtail, abolish, or terminate his authority to perform such function; or to limit, curtail, abolish, or terminate his authority to delegate, redelegate, or terminate any delegation of functions.

(j) References in chapter to provision of law deemed to include references thereto as amended or supplemented

Any reference in this chapter to any provision of law shall be deemed to include, as appropriate, references thereto as now or hereafter amended or supplemented.

(k) Functions conferred by chapter deemed in addition to and not substitution for functions existing before effective date

Except as may be otherwise expressly provided in this chapter, all functions expressly conferred by this chapter shall be in addition to and not in substitution for functions existing immediately before the effective date of this chapter and transferred by this chapter.

(Pub. L. 93-438, title III, § 301, Oct. 11, 1974, 88 Stat. 1248.)

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NATIONAL ENVIRONMENTAL POLICY ACT OF 1969

§ 4331. Congressional declaration of national environmental policy

(a) The Congress, recognizing the profound impact of man's activity on the interrelations of all components of the natural environment, particularly the profound influences of population growth, high-density urbanization, industrial expansion, resource exploitation, and new and expanding technological advances and recognizing further the critical importance of restoring and maintaining environmental quality to the overall welfare and development of man, declares that it is the continuing policy of the Federal Government, in cooperation with State and local governments, and other concerned public and private organizations, to use all practicable means and measures, including financial and technical assistance, in a manner calculated to foster and promote the general welfare, to create and maintain conditions under which man and nature can exist in productive harmony, and fulfill the social, economic, and other requirements of present and future generations of Americans.

(b) In order to carry out the policy set forth in this chapter, it is the continuing responsibility of the Federal Government to use all practical means, consistent with other essential considerations of national policy, to improve and coordinate Federal plans, functions, programs, and resources to the end that the Nation may—

(1) fulfill the responsibilities of each generation as trustee of the environment for succeeding generations;

(2) assure for all Americans safe, healthful, productive, and esthetically and culturally pleasing surroundings;

(3) attain the widest range of beneficial uses of the environment without degradation, risk to health

or safety, or other undesirable and unintended consequences;

(4) preserve important historic, cultural, and natural aspects of our national heritage, and maintain, whenever possible, an environment which supports diversity and variety of individual choice;

(5) achieve a balance between population and resource use which will permit high standards of living and a wide sharing of life's amenities; and

(6) enhance the quality of renewable resources and approach the maximum attainable recycling of depletable resources.

(c) The Congress recognizes that each person should enjoy a healthful environment and that each person has a responsibility to contribute to the preservation and enhancement of the environment.

(Pub. L. 91-190, title I, § 101, Jan. 1, 1970, 83 Stat. 852.)

* * * * *

§ 4332. Cooperation of agencies; reports; availability of information; recommendations; international and national coordination of efforts

The Congress authorizes and directs that, to the fullest extent possible: (1) the policies, regulations, and public laws of the United States shall be interpreted and administered in accordance with the policies set forth in this chapter, and (2) all agencies of the Federal Government shall—

(A) utilize a systematic, interdisciplinary approach which will insure the integrated use of the natural and social sciences and the environmental design arts in planning and in decisionmaking which may have an impact on man's environment;

(B) identify and develop methods and procedures, in consultation with the Council on Environmental

Quality established by subchapter II of this chapter, which will insure that presently unquantified environmental amenities and values may be given appropriate consideration in decisionmaking along with economic and technical considerations;

(C) include in every recommendation or report on proposals for legislation and other major federal actions significantly affecting the quality of the human environment, a detailed statement by the responsible official on—

(i) the environmental impact of the proposed action,

(ii) any adverse environmental effects which cannot be avoided should the proposal be implemented,

(iii) alternatives to the proposed action,

(iv) the relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity, and

(v) any irreversible and irretrievable commitments of resources which would be involved in the proposed action should it be implemented.

Prior to making any detailed statement, the responsible Federal official shall consult with and obtain the comments of any Federal agency which has jurisdiction by law or special expertise with respect to any environmental impact involved. Copies of such statement and the comments and views of the appropriate Federal, State, and local agencies, which are authorized to develop and enforce environmental standards, shall be made available to the President, the Council on Environmental Quality and to the public as provided by section 552 of title 5, and shall accompany the proposal through the existing agency review processes;

(D) Any detailed statement required under subparagraph (C) after January 1, 1970, for any major Federal action funded under a program of grants to States shall not be deemed to be legally insufficient solely by reason of having been prepared by a State agency or official, if:

(i) the State agency or official has statewide jurisdiction and has the responsibility for such action,

(ii) the responsible Federal official furnishes guidance and participates in such preparation,

(iii) the responsible Federal official independently evaluates such statement prior to its approval and adoption, and

(iv) after January 1, 1976, the responsible Federal official provides early notification to, and solicits the views of, any other State or any Federal land management entity of any action or any alternative thereto which may have significant impacts upon such State or affected Federal land management entity and, if there is any disagreement on such impacts, prepares a written assessment of such impacts and views for incorporation into such detailed statement.

The procedures in this subparagraph shall not relieve the Federal official of his responsibilities for the scope, objectivity, and content of the entire statement or of any other responsibility under this chapter; and further, this subparagraph does not affect the legal sufficiency of statements prepared by State agencies with less than statewide jurisdiction.[1]

(E) study, develop, and describe appropriate alternatives to recommend courses of action in any

[1] So in original. The period probably should be a semicolon.

proposal which involves unresolved conflicts concerning alternative uses of available resources;

(F) recognize the worldwide and long-range character of environmental problems and, where consistent with the foreign policy of the United States, lend appropriate support to initiatives, resolutions, and programs designed to maximize international cooperation in anticipating and preventing a decline in the quality of mankind's world environment;

(G) Make available to States, counties, municipalities, institutions, and individuals, advice and information useful in restoring, maintaining, and enhancing the quality of the environment;

(H) initiate and utilize ecological information in the planning and development of resource-oriented projects; and

(I) assist the Council on Environmental Quality established by subchapter II of this chapter.

(Pub. L. 91-190, title I, § 102, Jan. 1, 1970, 83 Stat. 853; Pub. L. 94-83, Aug. 9, 1975, 89 Stat. 424.)

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COUNCIL ON ENVIRONMENTAL QUALITY PREPARATION OF ENVIRONMENTAL IMPACT STATEMENTS: GUIDELINES

Title 40—Protection of the Environment

CHAPTER V—COUNCIL ON ENVIRONMENTAL QUALITY

PART 1500—PREPARATION OF ENVIRONMENTAL IMPACT STATEMENTS: GUIDELINES

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§ 1500.1 Purpose and authority.

(a) This directive provides guidelines to Federal departments, agencies, and establishments for preparing detailed environmental statements on proposals for legislation and other major Federal actions significantly affecting the quality of the human environment as required by section 102(2)(C) of the National Environmental Policy Act (P.L. 91-190, 42 U.S.C. 4321 et seq.) (hereafter "the Act"). Underlying the preparation of such environmental statements is the mandate of both the Act and Executive Order 11514 (35 FR 4247) of March 5, 1970, that all Federal agencies, to the fullest extent possible, direct their policies, plans and programs to protect and enhance environmental quality. Agencies are required to view their actions in a manner calculated to encourage productive and enjoyable harmony between man and his environment, to promote efforts preventing or eliminating damage to the environment and biosphere and stimulating the health and welfare of man, and to enrich the understanding of the ecological systems and natural resources important to the Nation. The objective of section 102(2)(C) of the Act and of these guidelines is to assist agencies in implementing these policies. This requires agencies to build into their decisionmaking process, beginning at the earliest possible point, an appropriate and careful consideration of the environmental aspects of proposed action in order that adverse environmental

effects may be avoided or minimized and environmental quality previously lost may be restored. This directive also provides guidance to Federal, State, and local agencies and the public in commenting on statements prepared under these guidelines.

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§ 1500.8 Content of environmental statements.

(a) The following points are to be covered:

(1) A description of the proposed action, a statement of its purposes, and a description of the environment affected, including information, summary technical data, and maps and diagrams where relevant, adequate to permit an assessment of potential environmental impact by commenting agencies and the public. Highly technical and specialized analyses and data should be avoided in the body of the draft impact statement. Such materials should be attached as appendices or footnoted with adequate bibliographic references. The statement should also succinctly describe the environment of the area affected as it exists prior to a proposed action, including other Federal activities in the area affected by the proposed action which are related to the proposed action. The interrelationships and cumulative environmental impacts of the proposed action and other related Federal projects shall be presented in the statement. The amount of detail provided in such descriptions should be commensurate with the extent and expected impact of the action, and with the amount of information required at the particular level of decisionmaking (planning, feasibility, design, etc.). In order to ensure accurate descriptions and environmental assessments, site visits should be made where feasible. Agencies should also take care to identify, as appropriate, population and growth characteristics of the affected area and any population and growth assumptions used to justify the project or program or to determine secondary population and growth impacts resulting from the proposed action and its alternatives (see paragraph (a)(1)(3)(ii), of this section).

In discussing these population aspects, agencies should give consideration to using the rates of growth in the region of the project contained in the projection compiled for the Water Resources Council by the Bureau of Economic Analysis of the Department of Commerce and the Economic Research Service of the Department of Agriculture (the "OBERS" projection). In any event it is essential that the sources of data used to identify, quantify or evaluate any and all environmental consequences be expressly noted.

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(b) In developing the above points agencies should make every effort to convey the required information succinctly in a form easily understood, both by members of the public and by public decisionmakers, giving attention to the substance of the information conveyed rather than to the particular form, or length, or detail of the statement. Each of the above points, for example, need not always occupy a distinct section of the statement if it is otherwise adequately covered in discussing the impact of the proposed action and its alternatives—which items should normally be the focus of the statement. Draft statements should indicate at appropriate points in the text any underlying studies, reports, and other information obtained and considered by the agency in preparing the statement including any cost-benefit analyses prepared by the agency, and reports of consulting agencies under the Fish and Wildlife Coordination Act, 16 U.S.C. 661 et seq., and the National Historic Preservation Act of 1966, 16 U.S.C. 470 et seq., where such consultation has taken place. In the case of documents not likely to be easily accessible (such as internal studies or reports), the agency should indicate how such information may be obtained. If such information is attached to the statement, care should be taken to ensure that the statement remains an essentially self-contained instrument, capable of being understood by the reader without the need for undue cross reference.

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COUNCIL ON ENVIRONMENTAL QUALITY REGULATIONS

40 C.F.R. CHAPTER 5 (1981)

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§ 1500.1 Purpose.

(a) The National Environmental Policy Act (NEPA) is our basic national charter for protection of the environment. It establishes policy, sets goals (section 101), and provides means (section 102) for carrying out the policy. Section 102(2) contains "action-forcing" provisions to make sure that federal agencies act according to the letter and spirit of the Act. The regulations that follow implement section 102(2). Their purpose is to tell federal agencies what they must do to comply with the procedures and achieve the goals of the Act. The President, the federal agencies, and the courts share responsibility for enforcing the Act so as to achieve the substantive requirements of section 101.

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§ 1500.3 Mandate.

Parts 1500-1508 of this title provide regulations applicable to and binding on all Federal agencies for implementing the procedural provisions of the National Environmental Policy Act of 1969, as amended (Pub. L. 91-190, 42 U.S.C. 4321 et seq.) (NEPA or the Act) except where compliance would be inconsistent with other statutory requirements. These regulations are issued pursuant to NEPA, the Environmental Quality Inprovement Act of 1970, as amended (42 U.S.C. 4371 et seq.) section 309 of the Clean Air Act, as amended (42 U.S.C. 7609) and Executive Order 11514, Protection and Enhancement of Environmental Quality (March 5, 1970, as amended by Executive Order 11991, May 24, 1977). These regulations, unlike the predecessor guidelines, are not confined to sec. 102(2)(C) (environmental impact statements). The regulations apply to the whole of sec-

tion 102(2). The provisions of the Act and of these regulations must be read together as a whole in order to comply with the spirit and letter of the law. It is the Council's intention that judicial review of agency compliance with these regulations not occur before an agency has filed the final environmental impact statement, or has made a final finding of no significant impact (when such a finding with result in action affecting the environment), or takes action that will result in irreparable injury. Furthermore, it is the Council's intention that any trivial violation of these regulations not give rise to any independent cause of action.

§ 1500.4 Reducing paperwork.

Agencies shall reduce excessive paperwork by:

(a) Reducing the length of environmental impact statements (§ 1502.2(c)), by means such as setting appropriate page limits (§§ 1[illegible]1.7(b)(1) and 1502.7).

(b) Preparing analytic rather than encyclopedic environmental impact statements (§ 1502.2(a)).

(c) Discussing only briefly issues other than significant ones (§ 1502.2(b)).

(d) Writing environmental impact statements in plain language (§ 1502.8).

(e) Following a clear format for environmental impact statements (1502.10).

(f) Emphasizing the portions of the environmental impact statement that are useful to decisionmakers and the public (§§ 1502.14 and 1502.15) and reducing emphasis on background material (§ 1502.16).

(g) Using the scoping process, not only to identify significant environmental issues deserving of study, but also to deemphasize insignificant issues, narrowing the scope of the environmental impact statement process accordingly (§ 1501.7).

(h) Summarizing the environmental impact statement (§ 1502.12) and circulating the summary instead of the entire environmental impact statement if the latter is unusually long (§ 1502.19).

(i) Using program, policy, or plan environmental impact statements and tiering from statements of broad scope to those of narrower scope, to eliminate repetitive discussions of the same issues (§ 1502.4 and 1502.20).

(j) Incorporating by reference (§ 1502.21).

(k) Integrating NEPA requirements with other environmental review and consultation requirements (§ 1502.25).

(l) Requiring comments to be as specific as possible (§ 1503.3).

(m) Attaching and circulating only changes to the draft environmental impact statement, rather than rewriting and circulating the entire statement when changes are minor (§ 1503.4(c)).

(n) Eliminating duplication with State and local procedures, by providing for joint preparation (§ 1506.2), and with other Federal procedures, by providing that an agency may adopt appropriate environmental documents prepared by another agency (§ 1506.3).

(o) Combining environmental documents with other documents (§ 1506.4).

(p) Using categorical exclusions to define categories of actions which do not individually or cumulatively have a significant effect on the human environment and which are therefore exempt from requirements to prepare an environmental impact statement (§ 1508.4).

(q) Using a finding of no significant impact when an action not otherwise excluded will not have a significant effect on the human environment and is therefore exempt

from requirements to prepare an environmental impact statement (§ 1508.13).

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§ 1502.21 Incorporation by reference.

Agencies shall incorporate material into an environmental impact statement by reference when the effect will be to cut down on bulk without impeding agency and public review of the action. The incorporated material shall be cited in the statement and its content briefly described. No material may be incorporated by reference unless it is reasonably available for inspection by potentially interested persons within the time allowed for comment. Material based on proprietary data which is itself not available for review and comment shall not be incorporated by reference.

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